AN ECOLOGICAL ASSESSMENT
OF
STANDING STONE STATE FOREST
OVERTON AND CLAY COUNTIES, TENNESSEE

FINAL REPORT IN PARTIAL FULFILLMENT
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between

TENNESSEE DEPARTMENT OF AGRICULTURE

and

TENNESSEE DIVISION OF NATURAL HERITAGE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION

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Purpose

An ecological assessment of Standing Stone State Forest was conducted by the Tennessee Division of Natural Heritage in order to provide the Tennessee Division of Forestry with information on the current status and distribution of rare plants and animals, unique features, and habitats, and to provide management recommendations which would enable management of this state forest in a more ecologically sensitive manner.

The mission of the Tennessee Division of Forestry (TDF), Tennessee Department of Agriculture is to protect forest resources and promote their sustainable use through science-based forest management. According to TDF, "Sustainable management emphasizes different uses of the forest in different situations, but always avoids destructive exploitation or lost opportunities due to neglect or ignorance." The mission of the Tennessee Division of Natural Heritage (DNH), Department of Environment and Conservation is to restore and protect the plants, animals, and natural communities that represent the natural biological diversity of Tennessee. Ecological data gathered and maintained by DNH help direct conservation, restoration, and management activities throughout the state.

The target audience of this report is land managers at Standing Stone State Forest and other staff within TDF. That is not to say the methods and results herein have no use to an academic audience or other land managing agencies, but such use was secondary when the DNH and TDF implemented the, methods, and data presentation.

Site Description

Location, Geology, and Climate

The 8,490-acre Standing Stone State Forest is located in the northwestern portion of Overton County, Tennessee with a small portion in western Clay County. The State Forest lies just north of the community of Hilham and approximately ten miles south of the Kentucky state line. The area is accessible from Highway 52, approximately twelve miles northwest of Livingston, and from Highway 136 approximately 30 miles north of Cookeville (Figure 1). The State Forest is within the Upper Cumberland-Cordell Hull Watershed (HUC 05130106) and is mostly drained by Mill Creek and its tributaries. A small portion on the far western edge of the Forest drained by Right Fork of Dry Fork.

Most of the State Forest is contained on the Hilham 1:24000 USGS quadrangle with the eastern portion on the Livingston quadrangle and lies completely within the Eastern Highland Rim Physiographic Province. Although Braun (1950) classified this area within the Western Mesophytic Forest region, she indicated that this dissected portion of the Eastern Highland Rim is essentially a part of the Mixed Mesophytic Forest region. One of the primary differences that Standing Stone has with the Mixed Mesophytic Forest is the dominance of beech - as opposed to hemlock - in the ravine slopes.

A summary of the major soil types at Standing Stone can be found in Table 1. Eight geologic formations exist in the State Forest with Monteagle Limestone and Fort Payne Formation with Chattanooga Shale having the greatest surface area (Figure 2). The headwaters of streams at Standing Stone are underlain by the Fort Payne Formation and Chattanooga Shale while further downstream the geology is Leipers and Cathys Formations (Wilson and Colvin 1968).

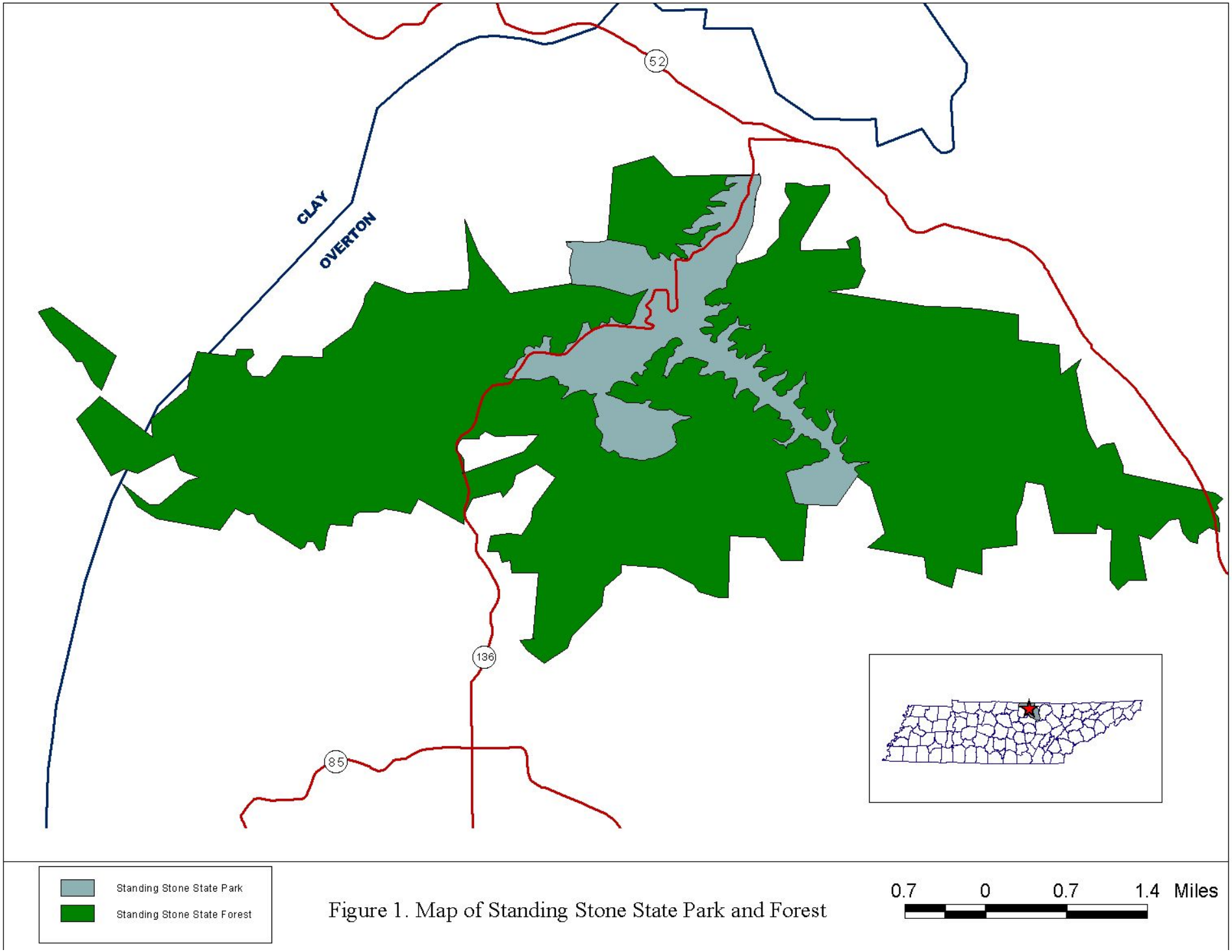

Figure 1. Map of Standing Stone State Park and Forest

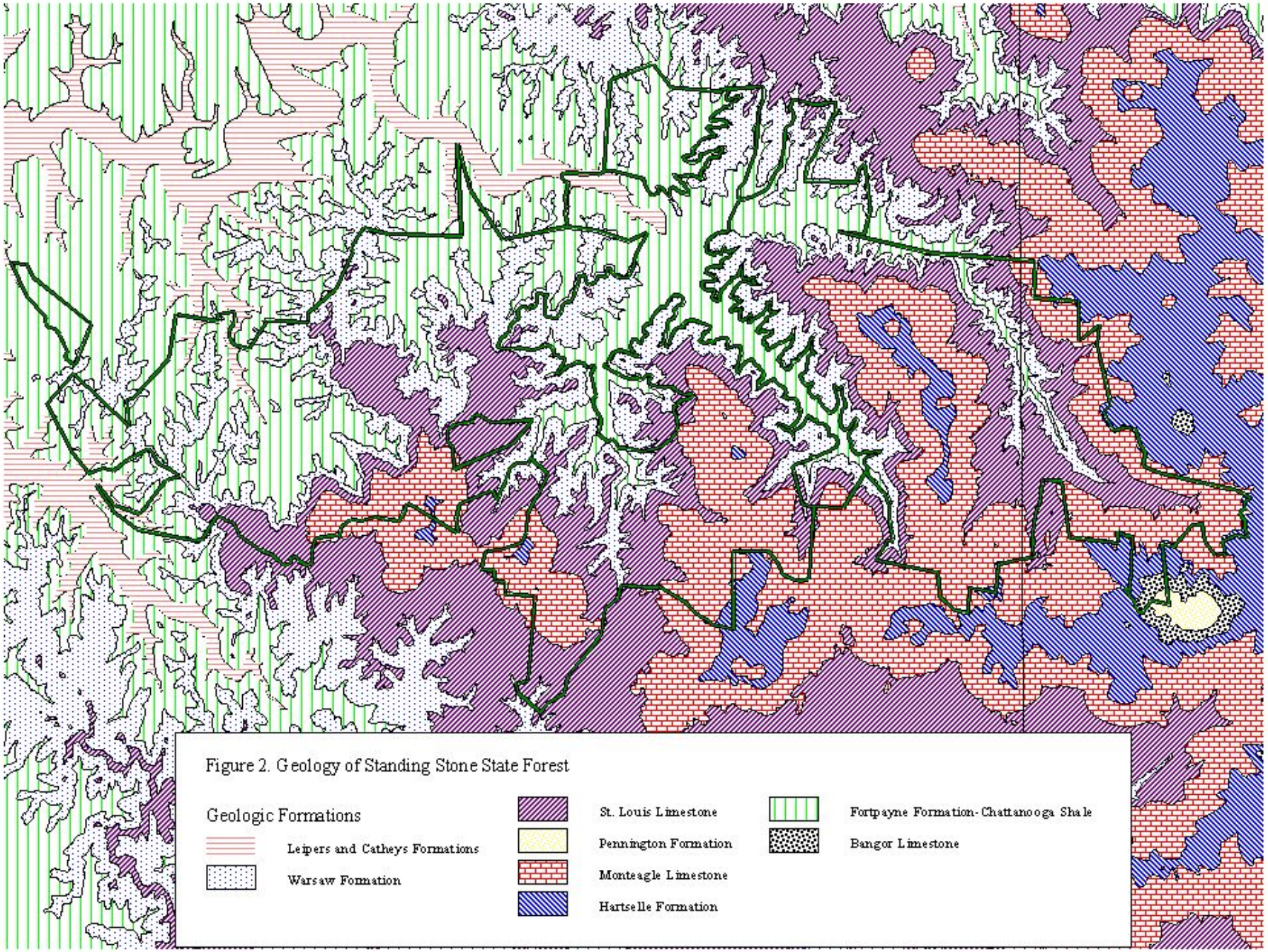
Figure 2. Geology of Standing Stone State Forest
Geologic Formations
Leipers and Catheys Formations
Warsaw Formation
St. Louis Limestone
Pennington Formation
Monteagle Limestone
Hartselle Formation
Fortpayne Formation-Chattanooga Shale
Bangor Limestone

The average winter temperature for Overton County is 27.5° F, and the average daily summer temperature is 74.1° F, with an average daily maximum temperature of 86.1° F. Total annual precipitation averages 52.3 inches, 57 % of which falls April through October (U.S. Department of Agriculture, Natural Resources Conservation Service 2004).

Land-Use History

The 1791 Treaty of the Holston pushed the Cherokee Indians west into the area of present-day Overton County. White settlers soon followed and in 1805 Moses Fisk surveyed the first community at present-day Hilham. In 1806 the Tennessee state legislature established Overton County, named for Nashville resident Judge John Overton (later a Tennessee Supreme Court justice) who owned land in the area (U.S. Department of Agriculture 2004).

Land clearing for farming and timbering soon followed settlement and by the early twentieth century there were at least 67 owners of what is now Standing Stone State Forest and Park. The "Standing Stone" was a large sandstone rock which delineated the boundary for the Cherokee Nation hunting grounds. However, this marker was not in the present day forest or park, but stood approximately 28 miles to the south (Eldridge 1976).

As a result of intensive land-clearing practices, soils were highly eroded and farms had a low productivity. To address these developing problems, the U.S. Government's Resettlement Administration began land acquisition in 1935 (Cowan 1968) and in 1939 the area was established as a demonstration project to "show how badly altered and eroded lands could be reforested" (Tennessee Department of Conservation 1971). Forestry related surveys during this time classified nearly 50% of the land as "old fields" and 81% of the area was "inoperable" in terms of timber production (Cowan 1968). The land was leased by the U.S. Department of

Agriculture to the State of Tennessee and was administered by the Department of Conservation, Division of State Parks.

Even while land was still being purchased for the demonstration project, members of the Works Progress Administration (WPA) and the Civilian Conservation Corps (CCC) began improvements. As with the other Depression-era projects on public lands, workers undertook such tasks as trail and cabin construction, dam and wall building, and reforestation activities. The limestone used in construction projects was mined from quarries within Standing Stone (Taylor and Wilson 1968). Specific activities included the construction of a fire tower and the damming of Mill Creek for the creation of Kelly Lake. Upstream from the lake, along Morgan Creek (in the present-day state park), a small swimming area was developed as was a group camp facility consisting of cabins constructed of chestnut lumber (Figure 3).[1] At the Standing Stone project area, each laborer worked 140 hours/month for a rate of $19/month (Mabry 1992).

In 1949, at the request of the U.S. Forest Service, the land was divided between the State Division of Forestry and Division of State Parks (Tennessee Department of Conservation 1971). In 1955 the land was deeded to the State of Tennessee. Currently the State Park is 855 acres and the State Forest is 8,490 acres, not including the two in-holdings which total 170 acres (Tennessee Department of Agriculture Division of Forestry 1996). Large tracts of land are in public ownership on Tennessee's Cumberland Plateau (e.g. Pickett State Forest, Big South Fork National River and Recreation Area, Catoosa Wildlife Management Area), but aside from the Arnold Engineering and Development Center Wildlife Management Area 80 miles to the south, Standing Stone State Forest is the largest public-land holding on the Eastern Highland Rim of Tennessee. The significance of Standing Stone and other conservation lands in Tennessee was

[1] Point 013 in accompaning GIS files. The state-listed eastern big-eared bat was found in some cabins.

Figure 3. Chestnut cabins remaining from Civilian Conservation Corps work at Standing Stone State Park

Figure 4. Kentucky coffee tree community with ash and *Diarrhena americana* in the ground layer

recognized as early at 1940 when the first-ever state conference on recreation was held at Standing Stone State Park (Tennessee Department of Conservation 1940).

Methods and Materials

Prior to field investigations a review of the rare species records in DNH's rare species database (Biotics) was conducted. The database contains information on specific locations of rare species, their site-specific habitat, directions, the last time the species was observed, etc. The review allowed the authors to determine which species would likely be encountered on the State Forest and to determine which habitats, locations, and times of year to search for rare plants and animals. Since only one rare species location was previously known from Standing Stone, other occurrence records in the surrounding vicinity were reviewed. Topographic maps were similarly reviewed to locate high concentrations of sinks and other karst features to investigate.

In addition to database and map reviews, inquiries were made to determine what previous biological research was conducted at Standing Stone. After contacting aquatic biologists from institutions including Tennessee Technological University, University of Tennessee, and the Tennessee Division of Water Pollution Control it appeared that no aquatic sampling had been conducted on the State Forest or State Park. Two zoological master's thesis conducted at Standing Stone were located. DeLotelle (1976) conducted a herpetological study and Smith (1976) undertook an ecological study of the wood frog (*Rana sylvatica*).

Mapping of Karst Features/Cave Exploration

Mapping of sinks, caves, and depressions began in the winter of 2004. All mapping was done with a Garmin GPSMAP 76S or 76CS global positioning system (GPS). Sinks were identified in the field, GPS points (waypoints) were taken, and staff took notes on the depth, diameter or other features such as the amount of exposed rock or the forest type in which the sink

was found. If the sink had a passable entrance or a cave was discovered, staff made an initial investigation to determine if a future visit was appropriate. If any rare species were observed, field forms were completed and data were entered into Biotics.

Karst habitats were a primary zoological focus due to the likelihood of encountering one state-listed animal and an abundance of unlisted or undescribed cavernicoles. The only targeted species was the eastern woodrat (*Neotoma magister* – deemed in need of management), a mammal that often provides the basis for complex subterranean food webs. Additionally, as several protected rare bats could potentially use larger caves for summer roosts, transitional habitats, or hibernacula, bats remained a target of this project as well.

The primary tools for locating survey areas included USGS 1:24,000 topographic maps, published accounts of caves, site information provided by the Tennessee Cave Survey (TCS), and leads provided by TDF personnel. Potential karst areas were reconnoitered by at least two DNH staff members via pedestrian surveys, primarily conducted in the winter and early spring. All significant features were documented by GPS. Staff members made written observations concerning the approximate dimensions and nature of each cave or sink. If possible, staff entered passable features to determine the subterranean dimensions and to examine the area for rare animals or signs thereof. Certain caves or sinks were targeted for a more thorough reexamination during the fall. Other sites, especially deep pits, were not explored due to limited staff experience with vertical rope work. However, the location of these sites was recorded by GPS and could be explored by experienced cavers at a later time. Most of the well-developed karst features at Standing Stone are pits and many have been explored by the TCS.

When examining subterranean features, staff members used standard safety protocols and common sense to avoid unnecessary risks to life, limb, or to the feature itself. Staff always

worked in pairs, and at a minimum wore approved safety helmets, gloves, and kneepads (as necessary), and carried multiple light sources. Purely technical sites, e.g. pits with sheer walls, were not pursued due to time and safety constraints.

Types of Karst Features

The karst features documented during this project were assigned to two coarse categories (caves and sinks), and were further refined with additional descriptors. Cave captures those features generally with large horizontal openings- usually walking, stoop, or crawl passage- and which contain accessible passages that extend beyond the twilight zone (area beyond which no surface light penetrates). The TCS maintains the master list of caves in Tennessee (currently containing over 8,500 sites), and requires a minimum of 50' of accessible horizontal passage for a site to qualify as a cave. Thus, a number of State Forest "caves" examined during this project may not meet the TCS threshold for inclusion in their database.

The assignment sink captures all other depressional karst features documented by DNH staff. This includes some features that may later qualify as caves, various types of depressions, and pits of different sizes. The following nomenclature was used to further describe sink qualities[2]:

Depressions were those sinks with gently sloping sides. Often these systems contained little exposed limestone, and were most frequently plugged or closed in the center. Seasonally, those depressions with a significant recharge area were flooded, then dried completely by late summer or early fall. Such features can be extremely important to local amphibian populations, because their periodic drying prevents the establishment of potential fish predators.

[2] Although DNH included this information in the GIS table, all of the various types are listed as SINK.

Pits were those sinks with generally abrupt or sheer vertical walls that could not be scaled without climbing gear, and which were too deep to safely enter without ropes. Pits could be open to view or embedded in other larger sinks. Generally, the recharge area of a pit was extremely limited and often did not extend beyond the rim of the pit itself. For a pit to qualify for TCS listing it must be at least 30' deep; some Standing Stone pits reported to the DNH by the TCS are over 100' deep[3].

True sinks were those features that did not accurately fit into any other category. The pitch of the walls varied, but the base of the sink could be accessed without technical climbing. Usually, extensive exposed limestone was associated with these features. The apparent recharge area varied tremendously, but was generally much less than that associated with depressions.

Sinking streams were observed periodically at Standing Stone, usually at the contact zone between two geologic formations. These were normally dry conveyances that contained flowing water following heavy downpours or after extended wet periods, although a few were perennial spring-fed features. A sinking stream can terminate in a closed- or open-throated depression, after which point its flow is wholly subsumed by subterranean (phreatic) channels. Sinking streams may also lose substantial flow to karst fractures within the streambed itself, rather than releasing all flow at its terminus. One sinking stream documented on the State Forest is so completely consumed by an associated cave that not even occasional surface flow is indicated between its insurgence and resurgence.

Tubes were caves characterized by stoop or crawl passages, some of which were sinusoidal and contained no accessible ancillary passages. Generally those at Standing Stone were dry.

[3] One such pit is documented at GIS point 210.

The modifiers closed-throated or open-throated could be applied to many of the categories noted above. Closed-throated sites were those which all collected water dissipated only by evaporation or percolation into the soil, either because no drain existed or because it was plugged with detritus or other native material. Open-throated sites contained an obvious, pervious drain into which collected surface water drained into phreatic passages beneath.

Of the organisms that may inhabit caves, troglobitic species are those that are cave-dependent (such as cave beetles), while troglophilic species are those that are adapted to cave life but are not obligate cave dwellers (such as woodrats).

Invertebrate Sampling

Cave Invertebrate Sampling

During initial reconnaissance, one small cave contained a particularly diverse invertebrate community, including amphipods, isopods, cave beetles, and flatworms- forms not necessarily common to most caves.[4] To better understand the biodiversity of this system, the assistance of The Nature Conservancy of Tennessee (TNC) was requested. TNC has been conducting a systematic inventory of the fauna of caves associated with the Cumberland Plateau in Tennessee for two years, and through this work has documented numerous rare species, many of which are new to science (Lewis 2004). As part of this work, TNC provided the expertise of cave researcher Dr. Julian J. Lewis for a more thorough examination of the cave in question. Dr. Lewis' methodology for invertebrate sampling includes hand collection, dip netting of pools, and the use of baited pitfall traps for more obscure species. Numerous such traps were placed in this cave and several nearby small caves in late October. Dr. Lewis will examine the specimens collected from this site and report his findings to TNC and DNH. Results of this work will

[4] Documented at GIS point 263.

provide greater insight into the overall invertebrate diversity at Standing Stone and the relationship of its species to others from the region.

Land Snails

Because of the abundance of limestone, limestone-influenced soils, rich coves, and mesic slopes, Standing Stone was expected to contain a diverse assemblage of land snails. Terrestrial molluscs are an important component particularly of forest ecosystems, acting as primary consumers of live and decaying plant material, fungi, and detritus. Dr. Brian Coles, a snail researcher who has conducted frequent inventories in Tennessee, agreed to sample representative habitats for rare species and overall diversity.

Amphibians

One of the more unusual habitats found on Standing Stone includes perched or depressional wetlands. These features are often in stark contrast to the terrain surrounding them, and can provide a seasonal water supply in areas with minimal surface streams. For many organisms those depressional wetlands are particularly valued as breeding grounds. Because these systems periodically dry out, fish do not become established and are not present to prey on various amphibian and insect larvae that use them seasonally.

The largest and best-known perched wetlands are found atop Cooper Mountain, though according to TDF staff, one wetland in particular is spring-fed and never dries completely. The largest depressional wetland is just west of Goodpasture Mountain on the south side of State Highway 292 (Baptist Ridge Road)[5]. Although these larger systems may support the greatest diversity of animal species, even small features- including "tip-up" holes from fallen trees, and road ruts- can provide habitat critical to the maintenance of numerous amphibian species on

[5] This site is mapped at point 191 in the accompanying GIS table.

Standing Stone. These habitats and other areas thought to yield information on amphibians were qualitatively surveyed by DNH staff.

Aquatic Sampling

Targeted aquatic sampling using nets and seines was conducted with the assistance of University of Tennessee Knoxville (UTK) ichthyologists. Sampling points included Bryans Fork, Morgan Creek and an unnamed tributary to Mill Creek on the north side of the State Forest[6]. Invertebrate specimens were preserved in 95% denatured ethyl alcohol and a formalin solution was used for fishes. All specimens were deposited at the UTK Research Ichthyological Collection.

In addition to the standard fish and benthos sampling conducted by UTK, DNH staff sampled representative stream segments for crayfish. Specimens were typed in the field or were preserved in 95% denatured ethyl alcohol for later examination. Preserved specimens were typed using standard keys (Hobbs 1989; Williams & Bivens 2001).

Botanical Surveys

Based upon a review of rare species records in the vicinity of Standing Stone, the authors determined that the most likely habitats where rare species could be found were mesic woods with a diverse spring flora. Topographic maps were reviewed and each blue-lined stream and many wet-weather conveyances were sampled during the spring, with emphasis on sheltered north and east-facing slopes. Throughout all investigations and all habitats, the flora was documented as were any additional rare plants. Any state-listed plant occurrences were mapped into the Biotics database.

[6] Sampling was conducted at GIS point 046. This area was named by researchers as Barn Hollow and the tributary is referred to as Barn Branch.

Although no attempt at a complete floristic inventory (vouchering all vascular plant species) was made, a list was maintained of all vascular plant species observed and the vascular plant list for Overton and Clay Counties (University of Tennessee Herbarium – TENN 2000) was consulted for the purpose of collecting previously undocumented species. Contributions to a county's flora allow botanists/biologists to better understand the distributions of both rare, common, and exotic plant taxa across the state and region.

The use of scientific names and common names follows that used on the University of Tennessee's Herbarium website (2004). A frequency of occurrence designation was used, as found in Murrell (1985) and Allowas (1994), which assigns a frequency designator to each species based upon the overall impression of abundance of that species in its habitat. The definitions for each frequency designation are as follows:

Very Rare – A single locality, few individuals
Rare – One or two localities, generally small populations
Scarce – Several localities or scattered small populations
Infrequent – Scattered localities throughout
Occasional – Well distributed but no where abundant
Frequent – Generally encountered
Common – Characteristic and dominant

Plant specimens were pressed, dried, and sent to the herbarium at the University of Tennessee, Knoxville. During field surveys, selected mosses were collected and sent to Dr. Paul Davison, bryologist at the University of North Alabama, for identification. Emphasis on moss collection was given to those locations which appeared uncommon at Standing Stone (e.g. cave openings, sinking streams, and select cemetery headstones).

Throughout the field investigations, notes on the various habitat types were kept. Recorded information included dominant overstory, understory and groundlayer plant species,

size class of trees, successional state, herbaceous diversity, presence of exotic species, and signs of disturbance. When a rare species was encountered and mapped in the Biotics data system this information was recorded in the "general description" field.

Documentation of Other Features

Throughout all field work, other features such as notably large trees, high-quality plant communities[7], areas in need of management (e.g. successional forests, restoration areas, trash piles, exotic plant infestations), or any other sites which warranted an additional visit were documented. Since the State Forest management plan calls for an undisturbed buffer around cemeteries and old house sites, all such features were noted along with other anthropogenic features (e.g. stone walls).

GPS and GIS Data Management

GPS points were uploaded and converted to an ArcView geographic information systems (GIS) shape file. Field notes relating to each GPS point were transcribed into the shape file's attribute table[8]. The attribute data for each waypoint include a unique identifier and categorical type. Upon completion of field work, shape files were merged. While in the field the GPS track log (tracing the route taken) was activated and those tracks were also loaded into GIS. This enabled the authors to determine which portions of the State Forest had been surveyed.

Digital Images

Digital images were taken throughout the project. All image files were saved in the .jpg format, sorted by general subject, renamed so users could determine image content, and burned to CD.

[7] A high-quality community is one which shows minimal disturbance or exotic plant infestations and/or a mature forested community of the type which did not seem abundant on the State Forest.
[8] For more complete details or instructions contact the Division of Natural Heritage.

Results and Discussion

Community Descriptions

The following community descriptions cannot cover all of the 8,490 acres of the State Forest, so it is definite that additional community types occur, and that each of the following descriptions could be further divided based upon dominance of a particular species or environmental variable. In addition, plant communities often blend with others and do not allow concrete boundaries, but rather edges or ecotones where one is gradually replaced by another (e.g. mesic ravine transition to a dry upland forest). This is especially true with the four different types of rich cove forests described below. The following are meant to provide land managers at Standing Stone State Forest with a description of the dominant plant communities and species likely to be encountered.

Big Tooth Aspen Community (Rich Cove)
Populus grandidentata-Sassafras albidum/Vaccinium stamineum-Viburnum acerifolium/Polystichum acrostichoides

This community was observed in only one area and is considered an early successional forest community. Big tooth aspen is the dominant species and fairly even aged with no stems greater than 10" diameter at breast height (dbh). Sassafras (*Sassafras albidum*) was the next most common tree encountered, but with much less frequency than big tooth aspen. Big tooth aspen likely became established after the last timber harvest of the site (ca 20 years ago), but was probably present locally. There was a substantial amount of coarse woody debris present from the most recent harvest. Other tree species scattered among the big tooth aspen include tulip tree (*Liriodendron tulipifera*), red oak (*Quercus rubra*), red maple (*Acer rubrum*), chinkapin oak (*Quercus muhlenbergii*), and white ash (*Fraxinus americana*). The herb layer is sparse and is mostly made up of ferns and green briers. Herbs include Christmas fern (*Polystichum*

acrostichoides), roundleaf greenbrier (*Smilax rotundifolia*), American hog peanut (*Amphicarpaea bracteata*), and perfoliate bellwort (*Uvularia perfoliata*). The community is clearly defined by the presence of big tooth aspen.

Mixed Hickory Forests (Dry Upland)
Carya tomentosa (*C. glabra*)-*C. ovata* (*Fagus grandifolia* on lower slopes)/*Acer saccharum*/sparse herb layer

This community is primarily found along the ridges and upper slopes and tends to be fairly dry. Pignut hickory (*Carya glabra*) may be included in the community and various oak species are usually scattered. This community is slightly different from an oak-hickory community, in that hickories are dominant. The herb layer is usually sparse and may consist of scattered hairy woodland brome (*Bromus pubescens*), pussytoes (*Antennaria* spp.), and bluet (*Houstonia purpurea*). This community may be influenced by the removal of oaks through past logging operations. The community usually becomes progressively more mesic immediately downslope transitioning to yellow buckeye (*Aesculus flava*), tulip tree, cucumber tree (*Magnolia acuminata*), sugar maple (*Acer saccharum*), and beech (*Fagus grandifolia*).

Oak-Hickory Forests (Upland-Rich Coves)
Quercus spp.-*Carya* spp./*Vaccinium*-*Viburnum*/sparse herb layer

This community typically occurs on ridges, finger ridges, and dry upland forests. Oak species vary from site to site but will typically include from greater to lesser frequency: white oak (*Quercus alba*), black oak (*Q. velutina*), chinkapin oak, chestnut oak (*Q. montana*), scarlet oak (*Q. coccinea*), and southern red oak (*Q. falcata*). Chestnut oak and scarlet oak tend to occur in areas where sandstone is the dominant geological type. Occasionally, red oak can be found within this community. The mix of hickories include mockernut (*Carya tomentosa*), pignut, and

southern shagbark (*C. ovata* var. *australis*). Other tree species scattered within the community include sourwood (*Oxydendrum arboreum*), tulip tree and sugar maple.

The shrub layer is typically composed of deerberry (*Vaccinium stamineum*), lowbush blueberry (*V. pallida*), maple-leaved viburnum (*Viburnum acerifolium*), and occasionally dogwood (*Cornus florida*). The herb layer is variable, but may include cypress panic grass (*Dicanthelium dichotomum*), nakedflower tick trefoil (*Desmodium nudiflorum*), pinesap (*Monotropa hypopithys*) and wreath goldenrod (*Solidago caesia*).

The composition of this community is no doubt affected by past logging. The assemblage of dominant and co-dominant species is also quite variable and may include a scattered tulip tree or other mesophytic species. Many of the commercially valuable oaks are within this community.

Oak-Vaccinium Community (Dry Upland)

Quercus velutina-Q. montana-Q. stellata/*Juniperus virginiana-Cornus florida-Vaccinium arboreum*/*Solidago* spp.-*Pellea atropurpurea-Antennaria* spp.

The oak-vaccinium community is distinct from the oak-hickory community in that the shrub layer is primarily ericaceous[9]. Many of the dominant tree species are similar to the oak-hickory community with the notable inclusion of post oak (*Quercus stellata*). Post oak tends to dominate in xeric, woodland conditions, which may develop on thin, limestone-derived soils. This community was observed at the top of a dry, shaley, west- and south-facing slope. Within this community, there is a lack of mesophytic species such as tulip tree. Shrub layer and small tree layer may include farkleberry (*Vaccinium arboreum*), eastern red cedar (*Juniperus virginiana*), dogwood, and elm (*Ulmus* sp.). Herbaceous cover is limited, but may include goldenrods (*Solidago* spp.), pussytoes (*Antennaria* spp.), alum root (*Heuchera villosa*),

[9] Within the Ericaceae plant family.

columbine (*Aquilegia canadensis*), and purple cliffbrake fern (*Pellea atropurpurea*). In more open or dry locations, hoary puccoon (*Lithospermum canescens*), St. John's wort (*Hypericum frondosum*), and little bluestem (*Schizachryium scoparium*) may occur. A unique variation of this community exists at Standing Stone and includes a dominance of mountain laurel[10] (*Kalmia latifolia*) in the shrub layer. This community tends to be geographically limited to small areas and may be considered a variation of the oak-hickory community.

Kentucky Coffee Tree Successional Community (Rich Cove)

Gymnocladus diocus-Fraxinus americana/*Ailanthus altissima-Gymnocladus*/*Diarrhena americana-Monarda clinopoda*

This community was observed in only one location on a historically disturbed knob, due north of the planted black walnut stand[11]. The structure of this community is unique due to the presence of Kentucky coffee tree (*Gymnocladus diocus*) in the under- and overstory (Figure 4). Other tree species associated with the understory and overstory include hackberry (*Celtis occidentalis*) sugar maple, red cedar, and chinkapin oak. The presence of the exotic tree-of-heaven (*Ailanthus altissima*) and other successional tree species in the community is probably due to past disturbances. Herbs typical of this community included a dominant stand of American beakgrain (*Diarrhena americana*) with white bergamot (*Monarda clinopoda*), American bellflower (*Campanula americana*), bloody butcher (*Trillium recurvatum*), and heartleaf skullcap (*Scutellaria ovata*). The presence of American beakgrain in this community is reminiscent of successional blue ash (*Fraxinus quadrangulata*) communities of the Central Basin (Tennessee Division of Natural Heritage 2003). Numerous limestone outcroppings on the knob provide habitat for ebony spleenwort (*Asplenium platyneuron*) and various bryophytes. The moisture regime within this community may tend to be xeric during the summer months.

[10] GIS point 193 documents this community.
[11] GIS point 270 documents this community.

Mesophytic Successional Forest (Rich Cove)

Fraxinus americana-Juglans nigra-Gymnocladus/Lindera benzoin-Acer saccharum/Cimicifuga racemosa-Caulophyllum thalictroides

This community was only observed in one location at Standing Stone and is probably influenced by past human disturbance. It is located on the north facing slope of Cooper Mountain along a tree-of-heaven infested roadway. Dominant mature tree species within this community include white ash, black walnut (*Juglans nigra*), black cherry (*Prunus serotina*), and Kentucky coffee tree. Some sassafras is present as mature multi-stemmed individuals. This community is composed of species considered successional, but the presence of the Kentucky coffee tree provides for a unique assemblage. The mature character of the community is noteworthy. Understory tree species include much of the previous dominants with the addition of sugar maple and black locust (*Robinia pseudoacacia*). Other mesophytic tree species such as beech, cucumber tree, tulip tree and oaks if present, were not dominant.

The shrub layer also includes sugar maple along with spicebush (*Lindera benzoin*) and poison ivy (*Toxicodendron radicans*). The herb layer is rich and typical of mesic forest conditions; species include black cohosh (*Cimicifuga racemosa*), blue cohosh (*Caulophyllum thalictroides*), Clayton's sweet cicely (*Osmorhiza claytonii*), Jack in the pulpit (*Arisaema triphyllum*), and yellow fairybells (*Diosporum lanuginosum*).

Beech-White Oak Ravine Community (Rich Cove)

Fagus grandifolia-Quercus alba/Acer saccharum-Fraxinus americana/Polystichum acrostichoides-Dodecatheon media-Jeffersonia diphylla

This community typically occurs in northerly facing slopes of mesic upper slopes, ravines, lower slopes, and alluvial terraces. A greater dominance of beech may indicate a history of oak harvesting. This community is quite widespread and common at Standing Stone and can vary widely. Associated species in the over- and understory include beech, white oak, sugar

maple, umbrella magnolia (*Magnolia tripetala*), chinkapin oak, and hophornbeam (*Ostrya virginiana*). Other species found in the understory may include basswood (*Tilia americana*), red mulberry (*Morus rubra*), and tulip tree. The shrub layer includes spicebush, blue beech (*Carpinus caroliniana*) and hydrangea (*Hydrangea arborescens*). The herb layer is quite diverse in the spring and not easily characterized. Depending upon the disturbance regime and microhabitat regimes, Christmas fern, foamflower (*Tiarella cordifolia*), twinleaf (*Jeffersonia diphylla*), dogtooth violet (*Erythronium americanum*), shooting star (*Dodecatheon media*), and blisterwort (*Ranunculus recurvatus*) are typical associates.

Tulip Poplar-Beech Mixed Mesophytic Community (Rich Cove)

Liriodendron tulipifera-Fraxinus americana-Fagus grandifolia/*Aesculus flava-Acer saccharum-Lindera benzoin*/*Trillium* spp.-*Tiarella cordifolia-Hepatica nobilis*

The community can be found in a number of lower mesic slopes, floodplain terraces and sinkholes throughout the State Forest. Although the dominant species include tulip tree, beech, and white ash, other species such as black cherry, sassafras, and sugar maple may be co-dominant especially in sinkholes. Understory species may include umbrella magnolia, basswood, yellow buckeye, and occasionally yellowwood (*Cladratis lutea*). The shrub layer is typically composed of sugar maple, dogwood, spicebush, and may also include basswood or hydrangea. The herb layer is diverse especially in the spring and early summer. Species found include *Trillium* spp., violets (*Viola* spp.), foamflower, liverleaf (*Hepatica nobilis*), yellow fumewort (*Corydalis flavula*), spring beauty (*Claytonia* spp.), bloodroot (*Sanguinaria canadensis*), celandine poppy (*Stylophorum diphyllum*), and sweet cicely.

Within this community there is significant variability among the dominant and co-dominant species of trees. Species such as white oak, red oak, chinkapin oak, and pignut hickory may be present in older or less disturbed stands of this community. The difference between the

tulip poplar-beech mixed mesophytic community and beech-white oak ravine community is related to the moisture regime and the primary dominance of tulip poplar. The wildflower diversity tends to be greater within the tulip poplar-beech mixed mesophytic. However, the two communities can be similar and perhaps thought of as a mesic ravine community (Figure 5).

Seasonally Saturated Depressional Wetland (Wetland)

Acer rubrum-Quercus lyrata-Liquidambar styraciflua/*Asimina triloba-Acer rubrum*/*Carex typhina-Apios americana-Oxypolis rigidior*

There was only one example of this community at Standing Stone.[12] The depressional wetland holds water during the cooler, wetter seasons and may temporarily hold water during heavy rain events in the summer. However, standing water is not present in the summer, but soils remain saturated and void of an herbaceous layer. Transitional areas from open water to dry-mesic forest tend to be rather acidic and include sphagnum moss; this is especially true on the northern side of the wetland. As the topography rises from the wetland, the community becomes dominated by white oak and beech.

Dominant tree species in the this community include red maple, overcup oak (*Quercus lyrata*), and sweetgum (*Liquidambar styraciflua*). Other tree species in the immediate vicinity are gum (*Nyssa sylvatica*) and beech. Shrub and understory species include red maple and pawpaw (*Asimina triloba*). The herbaceous layer is rather sparse but may be comprised of cattail sedge (*Carex typhina*), groundnut (*Apios americana*), and stiff cowbane (*Oxylepis rigidior*). Two state listed species occur within this wetland community: four-toed salamander (*Hemidactylium scutatum*) and southern twayblade (*Listera australis*).

[12] This wetland is located along Highway 292 (Baptist Ridge Road).

Figure 5. Mesophytic ravine community

Figure 6. Wildflower show of false rue anemone (*Enemion biternatum*)

In addition to the above communities, there exists former and current pine plantations, an artificially maintained warm-season grass field and various disturbed habitats along roadways, powerlines, cemeteries or other disturbed areas.

Many of the above communities contained flowering dogwood as an understory component. Although not abundant, the species was easily found in dry-mesic forests and often occurs in broad depressions. Dogwood is found throughout eastern North America and is a common understory species in the southeastern U.S. It has been documented in virtually every county in Tennessee. Although quantitative data were not collected, casual observations at Standing Stone indicate that many of the dogwood trees are diseased, likely from dogwood anthracnose.

Dogwood anthracnose is caused by the fungal agent *Discula destructiva*. The pathogen may have been introduced from Asian nursery stock and the disease was first detected in the U.S. in the late 1970s (Heirs and Evans 1997). Upon infection, lesions appear on the leaves, spreads from the leaf petiole into the branches and finally into the trunk (Carr and Banas 2000). The disease is capable of causing great mortality in areas were dogwood is common (Williams and Moriarity 1999). In their study of dogwood mortality on forests of the Cumberland Plateau in Tennessee, Hiers and Evans (1997) found a dramatic decline in stem density of dogwood and concluded that the loss of flowering dogwood in significant numbers is inevitable.

Botany/Flora Notes

The flora of Standing Stone is a great representation of the botanically diverse, mesic section of the Eastern Highland Rim of Tennessee. Much of the plant diversity is influenced by the cool, rich, limestone ravines and alluvial terraces which dominate the landscape. This diversity is evident in the spring with a profusion of wildflowers. Prior to full leaf-out in late

April, the forest floor, ravine slopes and alluvial terraces are carpeted with some 98 different species of wildflowers. Not all species occur in a single location, but differing assemblages of wildflowers occur across the diverse landscape (Figure 6). It is possible to have 40-50 species present in a single area. There are no endemics or federally listed species known from Standing Stone.

The most common genera of the spring flora include seven species of *Trillium*, five violets (*Viola*), four toothworts (*Dentaria*), and three bellflowers (*Uvularia*). The wildflower display in the spring is truly magnificent with colors such as blue (*Delphinium tricorne*, *Mertensia virginica*), yellow (*Stylophorum diphyllum*, *Ranunculus hispidus*), maroon (*Trillium cuneatum*), purple (*Viola rostrata*, *V. sororia*), red (*Trillium sulcatum*, *Silene virginica*), pink (*Geranium maculatum*, *Claytonia* spp.), green (*Disporum lanuginosum*, *Hybanthus concolor*) and white (*Thalictrum thalictroides*, *Trillium grandiflorum*). These wildflower displays are present in most rich, forested ravines and alluvial terraces in the State Forest.

Many of the vine, shrub, and tree species add to the diverse spring flowering colors. Paw paw, bladdernut (*Staphylea trifolia*), yellow buckeye, crossvine (*Bignonia capreolata*), and flowering dogwood all flower prior to full leaf out. Although the flowers for crossvine are high above the forest floor, the red-orange flowers readily detach from the plant and may be found on the ground.

A total of 379 species of vascular plants were documented from Standing Stone (Table 2) and 28 bryophyte species were collected (Table 3). Continued botanical fieldwork would likely yield additional species[13]. Typically, a minimum of two years is needed to conduct a thorough floristic inventory (this was not a goal for this project). Prior to this project, 622 species of vascular plants were known from Overton County (University of Tennessee Herbarium 2004).

[13] This is especially true with bryophytes for collections were only made from a few locations.

After DNH field investigations, an additional 114 plant species were vouchered as new to the flora of Overton County. An additional 40 species were observed as county records but were not collected or vouchered. The largest genus at Standing Stone is the oaks (*Quercus*) with twelve species represented. There would likely be a shift in the largest genus given more extensive botanical work. Sedges (*Carex*), *Aster*, or goldenrods (*Solidago*) would likely be the largest represented genus based upon similar plant inventories in the region.

Exotic Plant Species

A total of 23 exotic plant species were documented on the State Forest (Table 2).[14] This number is lower than expected, and would likely increase with more intense inventory of roadsides and management areas. An exotic plant species is one which has been introduced to the area outside of its native range.

The primary concern surrounding exotic species is they can be invaders of natural communities. Eleven exotic plant species documented from Standing Stone are listed as "Rank 1- Severe Threat" by the Tennessee Chapter of the Exotic Pest Plant Council (TN-EPPC). Severe Threat is defined as "exotic plant species that possess characteristics of invasive species and spread easily into native plant communities and displace native vegetation; includes species that are or could become widespread in Tennessee" (Tennessee Exotic Pest Plant Council 2001). Severe threat species include tree-of-heaven, mimosa (*Albizia julibrissin*), Russian olive (*Elaeagnus umbellata*), wintercreeper (*Euonymus fortunei*[15]), sericea lespedeza (*Lespedeza cuneata*), Chinese privet (*Ligustrum sinense*), bush honeysuckle (*Lonicera* x *bella*), Japanese honeysuckle (*Lonicera japonica*), Nepalese grass (*Microstegium vimenium*), princess tree

[14] Documented exotic plant species can be found the accompanying GIS table.
[15] This species was found only at one location and the entire plant was removed.

(*Paulownia tomentosa*), and multiflora rose (*Rosa multiflora*). These species are expected to persist, reproduce and increase their numbers on the State Forest.

Two non-native invasive plants listed as "Rank 2 – Significant Threat" were documented. A Significant Threat is defined as "exotic plant species that possess characteristics of invasive species but are not presently considered to spread as easily into native communities as those species listed as Rank 1" (Tennessee Exotic Pest Plant Council 2001). The species documented include Japanese barberry (*Berberis thunbergii*) and common periwinkle (*Vinca minor*). Periwinkle was primary limited to cemeteries, but appeared to be spreading into the surrounding forest. These species show some ability to invade floodplains, old fields, and open woods.

The most abundant exotic plant species at Standing Stone is tree-of-heaven. This species was found along roadsides, other disturbed areas and as lone trees or numerous saplings in the interior of forests (Figure 7). The worst infestation observed occurs in a cut-over area along Cooper Mountain Road. The Cooper Mountain infestation illustrates that this species can out-compete commercially valuable tree species on timber producing tracts. Nepalese grass was found on virtually every non-graveled and unpaved road or trail (Figure 8). The dominance of this exotic grass seemed to increase in more moist or shady conditions. Multiflora rose was occasionally encountered in bottomland habitats or other moist areas. Although Russian olive was not observed very often, it has completely dominated some old fields along the headwaters of Mill Creek. Japanese honeysuckle (*Lonicera japonica*) was found throughout Standing Stone with particularly bad infestations occurring in past pine plantations.

Additional non-native species were documented along disturbed roadsides, trails, and floodplains and can be considered agricultural weeds. Refer to Table 2 for a complete listing of these species.

Figure 7. Tree-of-heaven infestation in dry oak-hickory forest

Figure 8. Nepalese grass (*Microstegium vimineum*) infestation along interior road

Rare Plants

Prior to this survey no rare plant species were known from Standing Stone. A species previously considered rare - Gyndotte beauty - is known from the rich slopes and alluvial terraces. However, this species was dropped from the Tennessee Rare Plant Species list in 1999 due to increased knowledge on its distribution in Tennessee.

The 2004 field surveys lead to the discovery of 24 occurrences of six rare plant species (Table 4). The location of four rare species: bigtooth aspen, ginseng, southern twayblade and narrow-leaved ramps, represent Overton County records. Butternut was the most commonly encountered rare species on Standing Stone with twelve occurrences located. The most significant rare plant find was southern twayblade as it was only known from two counties in Tennessee prior to this investigation. Expected management effects on each of the rare plant species is summarized in Table 5.

Allium burdickii (narrow-leaved ramps)

A member of the lily family (Liliaceae), narrow-leaved ramps is known from nine counties across the state, but is more prevalent in eastern Tennessee. It ranges from Maine to North Dakota south to Tennessee and occurs in rich hardwood forests. The leaves of narrow-leaved ramps emerge in the early spring and persist until flowering, but are then absent during flowering. The pungent, odiferous leaves of this species, and the closely related ramps (*Allium tricoccum*), are harvested by collectors as a food and medicine. It is feared that ramp over-harvesting is causing the species to decline over its range. For this reason, the DNH lists the narrow-leaved ramps as a species of special concern and as commercially exploited.

The species tends to occur as scattered individuals or small groups of a few plants. Therefore, the species could be rather difficult to document unless the surveyor happens upon a plant. The distinctive garlic-like taste/odor and width of the leaves (present only in the spring)

are the best way to identify the species. Only two populations were documented, and the collection of narrow-leaved ramps represents an Overton County record. Narrow-leaved ramps may be considered elusive, but given the abundance of rich forest habitat, more narrow-leaved ramps may occur at Standing Stone.

Hydrastis canadensis (goldenseal)

A member of the buttercup family (Ranunculaceae), goldenseal is known from 44 counties throughout Tennessee. It tends to be more common in eastern Tennessee but may be found throughout. The range of goldenseal is broad across the eastern U.S. and includes Vermont to Wisconsin, west to Kansas, and south to Alabama, Georgia and Mississippi. The habitat for goldenseal is rich, mesic forests. The plants emerge in early spring and typically flowers as the leaves begin to expand (Figure 9). The flowers are small white plumes and fruit is red and visible in the summer. The foliage can be quite large and showy in the summer.

The roots of goldenseal are sought by plant collectors as a highly valued medicinal herb. Native Americans used goldenseal as an antiseptic, health tonic, treatment for snake bites, sore throats, and digestive disorders. Today goldenseal is a common herb of store shelves and is typically used to boost the immune system (Davis and McCoy 2000). It is feared that the harvesting of goldenseal roots is causing the species to decline over its range. For this reason, the Tennessee Division of Natural Heritage lists goldenseal as a species of special concern and as commercially exploited.

Only one occurrence of goldenseal was located at Standing Stone. Much of the appropriate habitat was surveyed in the spring, but no additional occurrences were located. Given the abundance of rich, mesic forests at Standing Stone, it is possible that more occurrences

Figure 9. The state-listed goldenseal (*Hydrasitis canadensis*),

Photo by Edward Chester

Figure 10. Green salamander (*Aneides aeneus*) under a limestone crevice

exist. However, the area has a history of human disturbance, and logging practices as well as herbal collections that may have caused the species to decline at Standing Stone.

Juglans cinerea (butternut)

A member of the walnut family (Juglandaceae), butternut is known from 40 counties in Tennessee and occurs in every state east of the Mississippi River except Florida. West of the Mississippi butternut is known from Arkansas, Missouri, and Iowa. The habitat butternuts are usually associated with include alluvial terraces to rich mesic slopes. Associated tree species include sugar maple, tulip tree, chinkapin oak, and beech.

The species is on the decline across its broad range due to a fungal blight caused by *Sirococcus clavigignenti-juglandacearum*. It is thought that the fungus was introduced from outside of North America and possibly infects trees through the terminal buds. Once infected, the trees develop irregular growths known as cankers. Over time, the cankers girdle a healthy tree and kill it. It is estimated that the fungal blight has caused an 80% decrease in living butternuts across some states (U.S. Department of Agriculture, Forest Service 1996). As a result of the decline due to the canker, this species is listed as threatened in Tennessee. All butternuts encountered at Standing Stone showed signs of butternut canker.

Butternut was the most common rare species encountered at Standing Stone. Twelve occurrences were documented within the State Forest with an additional two occurrences in the State Park. Although it was predictably encountered along stream terraces, only solitary trees or a few mature individuals were present in a limited area. No saplings or recruitment were observed, however nuts were observed in several locations as evidence of sexual reproduction.

Listera australis (southern twayblade)

A member of the orchid family (Orchidaceae), southern twayblade was known from only two counties in Tennessee (Fayette and Coffee) prior to this project. Due to the rarity in the state, the plant is listed as endangered in Tennessee. It has a southern and eastern range in the U.S., which includes Texas and Oklahoma east to Florida and north to Vermont, but is absent from the upper midwestern states such as Illlinois, Indiana, and Ohio. Southern twayblade occurs on saturated soils of acidic forested wetlands. It is closely associated with sphagnum mosses, and associated tree species include red maple, sweet gum, and paw-paw.

Southern twayblade is an early flowering, allusive orchid of forested wetlands. It can flower as early as March and the purple/brown coloration of the plant and flowers affectively camouflage it with the leaf litter. The small size of the plants adds to the elusiveness of the species.

Only one occurrence was located at Standing Stone. This one occurrence was not flowering at the time of observation and no specimen was taken. The plants could not be located upon a revisit in the summer; therefore, a follow-up visit should be made in spring 2005 for verification. Verification of southern twayblade at Standing Stone would be a county record for Overton and a significant range extension within Tennessee. Sound judgment should be made on whether to collect a specimen. In 2004 only 3-4 plants were observed.

Panax quinquefolius (ginseng)

A member of the ginseng family (Araliaceae), ginseng is known from 58 counties across Tennessee, but has been informally reported from nearly every county. It has a range of the entire eastern half of the United States. The typical habitat for ginseng is rich mesic forests, but it may occur in drier forest types.

Ginseng is a well-known plant due to its widespread use as an herbal panacea and remedy. Currently, international ginseng trade is regulated by CITES (Convention on International Trade of Endangered Species of Wild Fauna and Flora). Widespread legal digging and poaching has decreased the range of this once abundant plant. It is feared that the rate of ginseng harvesting is greater than the species' ability to reproduce itself. For this reason, the Tennessee Division of Natural Heritage lists ginseng as a species of special concern and as commercially exploited.

A total of eight occurrences of ginseng were located at Standing Stone. All occurrences consisted of 1-3 plants, therefore the viability of this species is not considered to be stable at Standing Stone. Abundant habitat exists for ginseng across Standing Stone, however the plants are absent from a majority of the appropriate habitat. Since the plants seem to occur in few numbers and in isolated areas, more plants may be present.

Populus grandidentata (bigtooth aspen)

A member of the willow family (Salicaceae), bigtooth aspen is widely scattered across seventeen northern and eastern Tennessee counties. It is known rangewide from the northeastern U.S. to the central southeast and north through the midwestern states. In Tennessee the species is listed as special concern. Bigtooth aspen is an early successional species and typically occurs in logged upland forests, and this is especially true at Standing Stone State Forest. Although the species may occur as widely scattered individuals within a cut-over forest, bigtooth aspen may also occur in dominant stands.

Only one occurrence was located at Standing Stone during the survey. The occurrence exists as a bigtooth aspen dominated community in a 15-20 year old clear cut. The species forms a dominant stand of mature, 6-8 inch dbh individuals. Regenerating forests and successional

communities are common throughout Standing Stone and it is possible that this species occurs elsewhere within the interior of a clearcut. Many of these areas are practically impenetrable to humans; therefore, access is physically limited to much of this habitat.

Other Interesting Botanical Finds

This section highlights several species that are not listed as rare but are nonetheless significant. These species are considered to be secure within Tennessee, but represent county records or noteworthy extensions of their range within the state.

Hexalectris spicata (spike crested coralroot orchid)

A native of Tennessee, this uncommon orchid is typically found in the mountains of east Tennessee. It is also found in two Eastern Highland Rim counties and two Central Basin counties. The discovery of this at Standing Stone makes the third county on the Eastern Highland Rim in Tennessee. Outside of the Appalachians in Tennessee, the spike crested coral root orchid may be considered rare.

Gymnocladus diocus (Kentucky coffee-tree)

The Kentucky coffee-tree occurs most commonly along the Mississippi River alluvial floodplain in western Tennessee. However, it does occur in several middle and eastern Tennessee counties. The occurrence of Kentucky coffee-tree at Standing Stone represents a county record and may represent the first collection on the Eastern Highland Rim physiographic province.

Castanea dentata (American chestnut)

The American chestnut once dominated the forests of eastern North America and was an important source of timber. Around 1906, a blight caused by a fungus *Endothia parasitica* was introduced along the Atlantic coast of the U.S. The blight totally devastated the American

chestnut across its range and currently it exists as resprouts from stumps. The species is listed as special concern, but DNH tracks only reproductive, fruiting occurrences of American chestnuts. Although no fruiting American chestnut trees were located at Standing Stone, stump sprouts were observed in several localities along dry ridge/upper slopes.

Synandra hispidula (Guyandotte beauty)

Standing Stone is known by wildflower enthusiasts as an excellent area to see the Guyandotte beauty. The pant is a very showy member of the mint family (Lamiaceae) and may be observed in late April and early May. In 1999 the species was dropped from the Tennessee Rare Plant List due to protection afforded by Standing Stone State Park and Forest plus recent range extensions in Tennessee. This species appears to be quite secure and common across Standing Stone

Trillium flexipes (bent trillium)

Bent trillium-which flowers in the early spring-is a showy species of rich limestone forests. Although this plant is not rare, it is characteristic of forests containing an abundance of spring wildflowers. Typically, bent trillium has white flowers, but a rare maroon form of the species has been referred to in floristic manuals and among botanists (Kentucky Native Plant Society 2004). This maroon form was found at Standing Stone associated with an area rich in spring wildflowers. The white flowered bent trillium is abundant in the central-northern portion of the state, while a maroon flowering bent trillium is not common. The bent trillium is in the lily family (Liliaceae).

Lonicera x *bella* (Bell's honeysuckle)

Bell's honeysuckle is native to Asia and is considered an aggressive invader of natural plant communities. This honeysuckle is considered a hybrid of the more widespread *L. tatarica*

and *L. morrowii*. Bell's honeysuckle was collected in the State Park just downstream of the Standing Stone Lake dam. The species may pose a future threat to the state forest. This represents the first collection of this hybrid honeysuckle in the state of Tennessee.

Animals at Standing Stone

Previously Known Rare Animals

Only one rare animal was known from Standing Stone State Forest prior to initiation of this inventory. A 1975 record of four-toed salamander (*Hemidactylium scutatum*) was recorded from upper Mill Creek in a Tennessee Technological University masters thesis (DeLotelle 1976). Recent animal surveys at Standing Stone yielded five additional rare species on the State Forest proper (Table 6), and literature reviews on the birds from Standing Stone (Table 7[16]) uncovered a 1951 report of the cerulean warbler (*Dendroica cerulea*) at the State Park (Ganier 1951). In addition to these rare species, the wood frog (*Rana sylvatica*) was studied as part of another Tennessee Tech masters thesis in the 1970s (Smith 1976). Though not rare, the species does have a limited distribution in the Eastern Highland Rim of Tennessee, and is generally associated with fishless, temporary pools.

Invertebrate Cave Inventory

Dr. Julian J. Lewis is currently examining specimens collected from the Table Rock Falls area (Slit Cave and environs) and plans to incorporate those data into a report due to TNC in January 2005. Those data will subsequently be provided to DNH and forwarded to TDF as an appendix.

[16] This list was provided by Stedman (2004) and there was no indication which species were found on the State Park versus the State Forest.

Land Snail Survey

From Dr. Coles brief July 2004 inventory of Standing Stone, 41 species of land molluscs were found. Included in his collection were specimens of *Zonitoides lateumbilicatus* (striate gloss), an S2 species tracked by the DNH. Dr. Coles summarizes his findings thus:

> Limited searches were made of woodland on limestone, primarily maple and beech/maple cove woodland. 41 Species of snail or slug were found, indicating a diverse fauna. The general impression was that the forest was rather uniform with respect to the larger species of snail. Small species (from a leaf litter sample) were sampled only in the cove woodland.
>
> Notable species were *Zonitoides lateumbilicatus*, which is restricted in distribution to central TN and adjacent Kentucky; this species was common in the cove woodland site. *Glyphyalinia cumberlandiana* is of note (seen as dead shells only) because this species is of restricted distribution and of taxonomic interest. Live material is required for study. "Patera perigrapta/laevior" presented anomalous forms that also require further investigation at a time of year more suitable for live adults. Other species were expected for central Tennessee or widespread in the eastern USA.
>
> The region would benefit from additional search in early spring, which is the best time for examining snail diversity. Cove woodland, particularly the areas of beech woodland, has the potential for greater diversity (33 of the 41 species seen in the cove woodland site 7.4); and this potential should be explored. Any site that presents unusual habitat (e.g., limestone talus) should be examined, and it should be noted that several species were seen only where there were limestone outcrops (site 7.3). Preservation of the mid-level cove woodlands is of priority to maintain the snail diversity of the forest.

Specimens collected or observed by Dr. Coles are presented in Table 8.

Aquatic Species

Results of brief aquatic surveys conducted for fishes by Dr. Tom Near *et al.* (UTK) and crayfish (DNH) are presented in Tables 9 and 10. Of note is the apparent abundance of a rare

fish, *Etheostoma obeyense* (barcheek darter), a species tracked by the DNH. Other fish and crayfish collected during these inventories are representative of streams in the area.

Rare Animal Species

At present, based on recent rare animal records and current observations, five state-listed species occur on Standing Stone or in close proximity to it. These include two mammals, one bird, and two amphibians. Additionally, several other demonstrably rare but unlisted (or non-statutory) species occur on or near Standing Stone. Each is described individually, below:

Aneides aeneus (green salamander)

The green salamander (Figure 10) was at one time listed as deemed in need of management by the TWRA, but was delisted in the 1990s due to increasing reports of extant populations in the state. Recently, however, researchers have considered the species a complex of several related species, and this single taxon may be split into several geographically restricted species (Corser, pers. comm.). For this reason, *A. aeneus* is considered a species of concern by the DNH.

At Standing Stone, the green salamander was reported at three locations, including the east slope of Goodpasture Mountain, from a minor knob near State Highway 292, and from a roadside cliff adjacent to Highway 136 near Mill Creek dam (in Standing Stone State Park). Documentation of the species at Standing Stone represents an extension of the species' known range into Overton County, though it previously has been reported from the Eastern Highland Rim of Tennessee. At one time the species was deemed a strong associate of moist sandstone outcrops, but more recently it has been observed on limestone outcrops in the Cumberland Plateau escarpment, and on trees with exfoliating bark (Withers 2003; Corser, pers. comm.).

Adults range from approximately 8-12 cm, with a dark dorsum covered with greenish lichen-shaped blotches (Redmond & Scott 1996). Their toe tips appear as expanded discs, a fit characteristic for their arboreal nature. Breeding generally occurs May-June and again September-October, with females laying fertilized eggs in damp rock crevices. Females brood eggs for up to three months, then guard hatchlings for several weeks until they disperse. Young probably mature 2-3 years after hatching (Petranka 1998).

Hemidactylium scutatum (four-toed salamander)

The four-toed salamander (state deemed in need of management) is an unusual plethodontid salamander primarily restricted to sphagnaceous bogs or similarly acidic or poorly buffered hydric soils. It was reported in 1975 from the upper portion of Mill Creek, though the exact location is unknown (DeLotelle 1976). During the DNH survey of Standing Stone it was documented from two additional locations, including the upland depressional wetland atop Cooper Mountain, and from the large seasonal wetland that straddles State Route 292 (Baptist Ridge Road).

The species has four toes on the front and hind feet, the latter making it distinctive among our terrestrial salamanders (Figure 11). They are usually 5-9 cm long, and have a visible constriction at the base of the tail that allows the animal to separate from the tail if attacked, thus improving chances of escape. The salamander's dorsum is a ruddy orange-yellow, sides grayish, and belly is white with black flecks (Eagar & Hatcher 1980). Breeding probably occurs in late summer and fall, with females laying eggs in early spring. Females guard the eggs for up to two months, after which point the young-of-the-year (YOY) hatch and move to nearby open water for approximately six weeks (Eagar & Hatcher 1980).

Figure 11. The state-listed four-toed salamander (*Hemidactylium scutatum*)

Figure 12. The state-listed eastern woodrat (*Neotoma magister*)

The four-toed salamander may be considered a signature species due to its association with sphagnaceous (or similar) habitats. Frequently these areas contain standing water as temporary (or vernal) pools, only holding water during wet periods or immediately following storm events. As such, the salamander has evolved in habitats that normally do not support fishes, and is likely less successful in areas modified for permanent water storage.

Dendroica cerulea (cerulean warbler)

The cerulean warbler (state deemed in need of management) is known from two historic observations from 1951 in Standing Stone State Park. Two nests were reported, including one that was located in a basswood tree that grew "near the base of a steep wooded hillside" and another ". . .nest was located on top of the ridge in a white oak tree that grew beside the Group Cabin near headquarters" (Ganier 1951). No recent observations have confirmed nesting in the area, but the species likely does at least pass through Standing Stone during spring and fall migrations.

The male cerulean warbler is identified easily, as this is our only blue-backed, white-throated warbler (Robbins 1983). A thin black throat band is also present in adult males (Robbins 1983). In recent years the species has been reported from spring breeding territories in the Cumberland Plateau of Tennessee (Welton 2001). Its habit is to construct nests in mature, relatively undisturbed deciduous forests with closed or semi-open forest canopies. Nests are located on the lateral limbs of a tree at considerable distances from both the ground and the bole (NatureServe 2004). Hamel (2000) notes that the habitat of the species is defined as "large tracts with big deciduous trees in mature to older-growth forest with horizontal heterogeneity of the canopy." Nests associated with a dense understory are generally less successful than those in

areas without (Oliarnyk 1996, in Hamel 2000). Cerulean warblers are primarily insectivorous, foraging on insects from various types of foliage (Hamel 2000).

Etheostoma obeyense (barcheek darter)

The barcheek darter was reported from three stream segments at Standing Stone (one on the Park in a drainage shared by the Forest). Though not currently listed by the Tennessee Wildlife Resources Agency, the species is tracked by the DNH due to its limited distribution in Tennessee. The brief survey conducted by Dr. Tom Near and students from the University of Tennessee documented the species for the first time in the Mill Creek watershed, and represents the most western and downstream record of the species in Cumberland River tributaries.

The species, which appears to be locally abundant in Standing Stone streams, ranged from 31-72 mm total length in specimens collected by Near et al. (Near 2004). The barcheek darter is colored a light tan with brownish markings including 6-8 dorsal saddles and 9-12 midlateral blotches (Etnier and Starnes 1993). Dorsal, anal, and caudal fins of males turn red when in breeding condition. Spawning occurs between April-June, thereafter males guard eggs laid under stones in clear upland streams (Etnier and Starnes 1993). Sexual maturity is probably reached within one year. Barcheek darters feed on various aquatic invertebrate larvae, but primarily midge larvae and mayfly nymphs (Etnier and Starnes 1993).

Typhlichthys subterraneus (southern cavefish)

Tennessee's only blind fish species, the southern cavefish (state deemed in need of management) has been reported from Water Supply Cave in Livingston. This site is approximately four miles SSE of the Standing Stone boundary. Although it was not found during the DNH surveys, many of the springs (and portions of caves) are inaccessible and may contain this species. This apparently unpigmented species is troglobitic, occurring solely in

phreatic environs. Range-wide they have been found in wet caves of varying sizes, in sinks, and have even been videotaped during drinking water well inspections (Tennessee Division of Natural Heritage 2003B).

The southern cavefish can reach a total length of 3.5", and feeds primarily on copepods, amphipods, and isopods (Etnier and Starnes 1993). Because of the species low fecundity, short life span, and sensitivity to chemical contaminants, the cavefish remains listed by the TWRA. Of the cave-dwelling vertebrates mentioned in this study, this species will be most directly affected by management actions that influence habitats in and near karst features that are linked to phreatic passages.

Corynorhinus rafinesquii (big-eared bat)

Though not observed on the State Forest during this study, the big-eared bat (state deemed in need of management) was documented at Standing Stone State Park in the abandoned CCC crew cabins. They most likely occur on the Forest, roosting in snags and hollow trees during the active season, and possibly in those habitats as well as some caves during the winter. *C. rafinesquii* is a medium-sized bat with distinctive, proportionally large ears approximately 27-37 mm long (Eagar & Hatcher 1980). The bases of ventral hairs are black with white tips, while dorsal pelage is gray (Eagar & Hatcher 1980). Like all other native Tennessee bats, the species is insectivorous, emerging at night to prey on flying insects. Although their natural roosts during the warmer months primarily include hollow trees, they are adroit at using man-made structures, including barns, hiking shelters, cabins, and even abandoned cisterns. In parts of west Tennessee devoid of caves and karst terrain, the species is sometimes reported in hollow water tupelo or bald cypress trees. Cave roosts typically occur just beyond the twilight zone. This is one of our

least densely roosting bats, in that they are typically found singly or in only small groups. A roost approaching 100 animals is considered exemplary and significant.

The species probably breeds in the fall, with females giving birth to a single pup in the spring. Young-of-the-year (YOY) reach adult size by September before first hibernation (Eagar & Hatcher 1980).

Neotoma magister (eastern woodrat)

The eastern woodrat (state deemed in need of management) is a ubiquitous, charismatic mammal likely present over much of Standing Stone (Figure 12). Woodrats, or evidence thereof, were observed in two caves examined in this study and in the abandoned CCC crew cabins on the State Park, and were suspected from numerous other locales. Additionally, Cory Holliday (TNC) reported seeing a woodrat during sampling of "Cooler Cave" in Andrew Cove.

The species is recognized by its soft pelage, brownish-gray on their backs and white underneath. Total length can approach 17", half of which is tail. The habitat of the species includes protected cliffs, rocky sinks, and forested talus. Woodrats tend to create easily recognizable nests made of dried grasses and other plant material. They liberally "decorate" their nests with fresh plant matter, cedar cuttings, and other greenery (Eagar & Hatcher 1980). Woodrats also habitually collect nuts and seeds and store them in or near the nest. They also tend to defecate in defined areas, or latrines. Decaying woodrat feces is often a food source for terrestrial cave invertebrates or their larvae. Because they typically forage outside the cave but defecate within it, they are a critical component to nutrient cycling in cave systems.

Despite their presence on Standing Stone, range-wide the species is under threat. Significant declines have been witnessed in the northern part of their range (New York, New Jersey, Pennsylvania), now attributed to a parasite called the raccoon roundworm (*Balyisascaris*

procyonis). The parasite can be transmitted to woodrats when raccoons leave infected feces in areas shared with woodrats. Currently the impact of this parasite on Tennessee woodrat populations is unknown, however, researchers remain concerned that epizootic will continue to push southward towards Tennessee (Henry, T.H. 2003, pers. comm.) This potential threat to Tennessee populations is a deciding factor in the species remaining listed as deemed in need of management.

Invertebrates of Interest

Orconectes australis (blind cave crayfish)

The blind cave crayfish is historically known from Raven Bluff Cave, approximately two miles northeast of the nearest Standing Stone property boundary, abutting the Mitchell Creek embayment of Dale Hollow Reservoir. Though unlisted, the blind cave crayfish is usually associated with high-quality, unperturbed cave streams and springs and thus the species likely occurs on Standing Stone. The blind cave crayfish is an albinistic, troglobitic crayfish, with adults ranging from 31-44 mm total length (Hobbs 1972). It is known from subterranean waters associated with the western edge of the Cumberland Plateau in Tennessee, Alabama, and Kentucky (Hobbs 1989). It is a long-lived, low-fecundity species, existing in a nutrient-poor environment for possibly several decades or longer.

Because of the proximity of Standing Stone to records of a closely related species in Jackson County (*Orconectes incomptus* – state endangered), examination of future specimens from Standing Stone is advisable. The taxonomy of the subterranean *Orconectes* is currently being examined (and possibly revised), and evaluation of the genetic relatedness of Standing Stone specimens to reference specimens of the two other taxa would be important to ongoing studies.

Kleptochthonius pluto (a cave pseudoscorpion)

Kleptochthonius pluto, a rare cave pseudoscorpion, also is known from Raven Bluff Cave. However, this is the only known location for the species to date. Because of the proximity to Standing Stone, this species may well occur on the Park or Forest. Members of this genus are small (some only 2-3 mm), eyeless, obligate cave dwellers. Most are highly endemic and may only be found at a few sites. Currently the DNH tracks twelve species in this genus, seven of which are known from a single cave. The DNH anticipates that members of this genus will be represented in the findings of Dr. Lewis.

Pseudanophthalmus robustus (a cave beetle)

Tennessee is host to scores of rare, restricted, or endemic cave beetles of the genus *Pseudanophthalmus*, many of which are tracked by the DNH. *P. robustus* is one of the more widespread forms, occurring in the Eastern Highland Rim from northern Grundy County to central Overton County (Barr 1962). Members of the "Robustus" group of cave beetles are generally eyeless, troglobitic, rufous-colored carabids. They are small and inconspicuous, averaging 3.8-5.6 mm long, though they are regarded as one of the larger cave beetle species (Barr 1962). They are one of the top invertebrate predators in cave ecosystems, consuming small millipedes, worms, and other small cave invertebrates (Barr 1962).

Two adult beetles were collected from "Little Slit Cave" at Standing Stone, approximately 0.7 mile due east of the Cooper Mountain summit, adjacent to Table Rock Trail and the more recognizable Slit Cave proper. This site was revisited by Dr. Lewis and will no doubt yield a treasure trove of cave invertebrate diversity.

Zonitoides lateumbilicatus (striate gloss)

The striate gloss is a small forest snail (4.2-5 mm dia.) known from northern Alabama, Tennessee, and east-central Kentucky (Burch 1962; Hubricht 1985). The species is a calciphile

found in leaf litter on wooded hillsides and ravines (Hubricht 1985). Its color is whitish and adults have approximately 4 ½ whorls (Burch 1962). The DNH tracks this species because of its apparently limited distribution in Tennessee and habitat specificity. Coles (2004) reported the species as common in leaf litter collected from a north-facing wooded cove draining to Mill Creek. The presence of this species is indicative of a mature overstory, lush herbaceous growth, rich humus, and substantial moisture. Portions of Standing Stone containing this species are significant and will likely support a diversity of other invertebrates and vertebrates not surveyed in this study.

Vernal Pools

Vernal, or temporary pools are one of the more interesting habitats on Standing Stone. Vernal pools can occur within natural closed depressions, as a result of road construction or earth moving, or alongside low-gradient intermittent stream channels. Even road ruts can behave as small vernal pools. Within Standing Stone, a number of large closed depressions provide the potential for numerous vernal pools. When occurring on tracts with few perennial streams, the presence of standing water indicates that these habitats will be particularly critical to animals with aquatic larvae during part of their life cycle.

Amphibians, in particular, benefit from these habitats. Because vernal pools dry up periodically, fish communities do not persist. The numerous salamanders, frogs, and toads that require standing water to nurture their eggs and larvae can be significantly impacted by fish predation. Having fishless bodies of water provides local amphibian populations an ideal habitat for this part of their life cycle.

Numerous other animals will utilize vernal pools seasonally. In particular, aquatic insects, including those terrestrial species that have an aquatic larval stage (e.g. dragonflies) also

benefit from fishless pools. At least two families of aquatic snails, Lymnaeidae and Physidae, prosper in vernal pools because of their remarkable fecundity and adaptations to temporary waters. The diversity of invertebrate organisms supported by these habitats provides food for numerous vertebrates, including waterfowl, wading shorebirds, and passerines. The presence of standing water- in some vernal pools even after a prolonged dry spell- also provides a necessary source of drinking water for game and nongame species alike.

Another critical function of depressional pools is their value as filters for the karst aquifer. In doing so, the vegetation, soil microbes, and other organisms can better assimilate nutrients and potential contaminants before they enter the groundwater. Because troglobitic organisms are generally adapted to low-nutrient conditions, the filtering capacity of depressional pools is of prime importance to the maintenance of subterranean habitats.

Karst Features

Many characteristics inherent in the biota of Standing Stone are attributable to its karst topography. The forest communities, rare plants, and rare animals are intimately tied to this landform. Without this foundation, much of the diversity and uniqueness of Standing Stone would not exist.

Of the various karst features on the property - including caves, sinks, and boulder fields- those that can be directly explored by humans are of great import. Caves in particular are remarkable, as they provide a refuge for numerous relatively large animals, specialized habitats for others, and give us a glimpse into some extremely ancient yet relatively unchanging environments.

The Tennessee Cave Survey (TCS) provided the DNH a list of caves and locations from Standing Stone. As most of the caves on Standing Stone are pits -many quite deep- these were not investigated by the DNH except around their perimeter.

The DNH did, however, document several other accessible features that were previously unknown to the TCS. Details of these will be provided to the TCS for record keeping.

Cultural Features

DNH staff recorded twenty historical structures consisting of old foundations, chimneys (Figure 13), walls and cemeteries. Depression-era maps of the Standing Stone project indicate schools which existed on the State Forest until Overton County consolidation. The historic structures and evidence of past disturbance further indicate that the vegetation on the State Forest has been greatly influenced by past land practices.

All of the previously known cemeteries were located during this survey except for two. One, located on the far east end of Table Rock Trail, was not located but the GPS track log indicated that DNH staff were in the correct spot. This cemetery is likely so old that there are no longer any visible signs of gravestones. The location of the other not visited by DNH staff is known to TDF staff[17]. Some of the cemeteries are well-known, occur along roads, and are maintained (e.g. Concord, Glascock, Tomkins), while others are very small and lie within the interior of the forest. Maintenance of cemeteries including brush and downed-tree removal is needed in the less-accessable sites (Figure 14).

Management Recommendations

The following recommendations provide TDF with information as to how best manage for ecologically significant features on the State Forest. Some recommendations may be site

[17] This is the Thompson Cemetery located along Table Rock Trail.

Figure 13. Standing chimney on old house site near Table Rock Trail

Figure 14. Woody debris in Savage Cemetery

specific while others are more general in nature, but all are meant to aid in the conservation of natural resources. These recommendations are not necessarily for best timber management (although there is likely some overlap), but take into account all features, especially rare species or unique habitats. The accompanying GIS layers will aid land managers in identifying areas where management is needed (e.g. exotic species infestations).

Limiting Vehicle Access

TDF has done a great job of gating roads in order to limit vehicle access, and consequently illicit vehicle use is minimal at Standing Stone. Should problems arise, gating or additional signage should diminish the amount of vehicle traffic, but realistically there is no way to completely eliminate all illegal vehicle use on the State Forest. ATVs can simply drive through the woods and around obstacles such as boulders, gates, or felled trees. Therefore, TDF staff may wish to regularly patrol problem areas (if any) in order to be a visual presence and issue citations as needed.

Management of Former Pine Plantations

If desired, former pine plantations could be managed/restored in a variety of ways including burning for grassland habitat, replanting in pines, or planting in hardwoods. Unless TDF wishes to place these areas back into pine production, the DNH recommends that they be allowed to naturally succeed and predicts the areas will eventually mature to hardwood forest. Such a natural succession to hardwoods would still allow for commercial timber management if desired. If TDF desires to reforest the sites with hardwoods, species which naturally occur on the State Forest should be used.

Some of the past pine plantations do contain infestations of exotic plant species and the presence of "Severe Threat" species on the State Forest (e.g. tree-of-heaven, sericea lespedeza,

bush honeysuckle, Japanese honeysuckle, and Nepalese grass). These areas should be regularly inspected to ensure that these species are not invading or increasing, and if they are, treatment should be implemented.

Land Management Near Karst Features

Certain traditional forestry practices on the State Forest must be tempered with the knowledge that many karst features are particularly sensitive habitats. Open-throated sinks and depressions are most susceptible to interference by mechanical, chemical, and pyric management activities, owing to the short retention time associated with the movement of water through them. The longer retention times associated with closed depressions normally allow for greater biological assimilation of extraneous materials, though certain management tools are best not used in these habitats as well. Generally, a manager's primary concern in karst areas should focus on the potential for surface waters to transport excessive nutrients or contaminants into the phreatic systems beneath the State Forest.

Fire is an obvious and valuable tool for achieving certain management objectives. In karst areas, however, the accumulation and transport of potash into sinks can markedly raise the pH of subterranean waters (increasing alkalinity), at least for a brief period. Although limestone aquifers are relatively well buffered, the allochthonous materials primarily received by these systems are normally acidic (e.g. tannic acid from decaying oak leaves, etc.). Although periodic fires may not be problematic, excessive, repetitive prescribed fires near sinkholes should be avoided. In general, open-throated karst features should be buffered from prescribed fires by a distance sufficient to permit potash-laden runoff to be absorbed by the soil prior to reaching an inflow point.

Likewise, large-scale or broadcast chemical management is ill-advised near karst features, particularly for open-throated sites. Prudent designation of buffers will prevent the unnecessary intrusion of foreign and particularly hazardous chemicals that may directly and negatively impact cave-dwelling organisms, or that may indirectly harm them by altering their food supply or other habitat features.

Although mechanical management and harvest can be undertaken in karst areas, care should be exercised to limit the soil disturbance in a given area. Many of the sinks on the State Forest are actively developing, and imprudent use of heavy equipment can accelerate this process to an unknown end. Also, an influx of sediment into perennial phreatic systems can negatively impact rare or sensitive cave species that have evolved in a stable and nutrient-poor environment. In general, fire lines, haul roads, and staging areas should be kept away from karst depressions. Harvest of particularly large trees from sinks may also not be advisable because of the development of extensive root systems integrated into the karst.

Animal Resources

Based solely on the rare animals documented herein, the TDF is advised to maintain appropriate buffers along water courses (protect riparian zones), cave, sink, and pit openings, cliff faces, and isolated wetlands. Riparian buffers are intended to reduce the contribution of sediment to streams from prescribed forestry activities, thereby protecting any aquatic species with a particular sensitivity to silt. The TDF is encouraged to partner with the TWRA and TDEC stream crews in periodically monitoring the health of these streams using standard methods. Karst openings should be protected from any unnecessary disturbance, as these systems may be particularly sensitive to changes in their nutrient input or forest character, or from increased sediment loading. Cliff faces should be buffered to prevent excessive drying (e.g. from loss of

canopy) in order to protect occurrences of the green salamander, other terrestrial salamanders, and land snails. Isolated wetlands should remain a safe distance from management activities, as any increase in sediment can have marked and negative impacts on developing amphibian larvae, including the four-toed salamander.

As part of the overall forest plan, TDF is encouraged to maintain a mosaic of habitats, including some proportion of standing hollow or dead timber. Hollow trees provide habitat for numerous forest species, and may be crucial roosting sites for big-eared bats and other protected species.

Sensitive Slopes and Ravines

Unlike other state forests such as Cedars of Lebanon, Standing Stone does not have a significant number of rare species. However, as a result of ground surveys during this project, a GIS layer indicating sensitive ravines was created[18]. Such areas comprise the steep, often botanically diverse slopes along the named tributaries and wet-weather conveyances[19]. The ravines (Figure 5) may or may not contain rare species but are important to the biodiversity of the State Forest.

Soil maps indicate that these areas are almost exclusively within the Garmon-Newbern soil complex. This soil type is shallow to moderately deep and is often found on steep to very steep slopes (40-80%). As a result, it is not well suited for equipment use due to the potential for erosion (U.S. Department of Agriculture Natural Resources Conservation Service 2004). Evidence of this high erosion potential was found even while walking parallel along the steep, often moist slopes. Based upon this high potential of erosion and the diverse spring flora,

[18] After field surveys, the GPS track log, and GIS stream coverage were used to identify the steep ravines and a 100-meter buffer was created to capture the areas upslope from the watercourses.
[19] For a more complete botanical description see the community types listed above.

alternatives to any management in these areas should be carefully considered and management should only be conducted in the driest of times.

Exotic Plant Management

As noted previously, invasive exotic plants pose a serious threat to native species and communities on the State Forest. If left unmanaged, they could threaten plant and animal biodiversity, reduce tree regeneration, usurp forest productivity, and hinder forest-use activities (Miller 2003). Because these species tend to spread aggressively and displace native vegetation, they should be considered a priority for management.

In the following sections, general management techniques for controlling exotic plants are discussed followed by detailed management prescriptions for those exotics species found on the State Forest which are listed as a "Severe Threat." These management techniques are intended to provide TDF staff with general information about the tools and strategies available for controlling invasive exotic plants. Typically, successful weed control will require the use of several methods. All available control options should be considered: manual, mechanical, grazing, prescribed fire, herbicides, and other, more novel techniques (Table 12). Each has advantages and disadvantages in terms of its effects against the target weed(s), impacts to non-target plants and animals, risks to human health and safety, and costs. When selecting control methods, keep in mind that the ultimate purpose of the work is not simply to eliminate the exotics, but rather to preserve native species and communities.

Manual and mechanical techniques such as pulling, grubbing, cutting, mowing, girdling, and tilling may be used to control some invasive plants, particularly if the population is relatively small. Annuals and tap-rooted plants are particularly susceptible to control by hand pulling or pulling using tools. This method is not as effective, however, against many perennial weeds with

deep underground stems and roots. Mowing and cutting are often used as primary treatments to remove aboveground biomass, to reduce seed production and to restrict weed growth, especially in annuals cut before they flower and set seed (Tu, Hurd, and Randall 2001). Manual and mechanical treatments must typically be administered several times to prevent the weed from re-establishing. While these techniques are generally labor and time intensive, they are extremely specific, minimizing damage to desirable plants and animals.

Prescribed fire can also be an effective and efficient tool for controlling the invasion of some exotic plants. Fire not only reduces the abundance of many woody and non-native plants, but it also enriches the soil, lengthens the growing season, and stimulates the germination of some native plants.

The most effective fires for controlling invasive plants are typically those administered at the young seedling/sapling stage or just before flower or seed set. In some cases, prescribed burns can unexpectedly promote an invasive species, such as when their seeds are adapted to fire. In these situations the burn prescription must be modified or other management actions taken to control the invasive plant. Spot-burning invasive weeds with a propane torch can be cheaper and easier than conducting a prescribed burn, but is only effective when the infestation is small.

Grazing is yet another method that can help reduce vigor of palatable invasive plants. The Nature Conservancy has used goats as part of an integrated approach to control privet on some of their Nature Preserves in Tennessee and has found this method to work well. The goats however, must be able to reach and destroy adult privet plants (Batcher 2000). Prescribed grazing can also be effective in controlling tree-of-heaven. The continued removal of the tops of seedlings and resprouts by grazing animals prevents seed formation and also gradually weakens

the underground parts. Grazing must be continued until the seedbank is eliminated, as the suppressed plants return quickly after livestock is removed (Hoshovsky 1988).

Extensive infestations may require more aggressive methods of control such as the selective application of herbicides to target exotic plants. In general, for work in natural areas, it is best to select herbicides that are effective against the weed, not likely to drift, leach to groundwater or wash into streams, that are nontoxic to people and other organisms, and are not persistent in the environment (Tu, Hurd, and Randall 2001). The selective methods described in this section are directed foliar application, cut-treat, stem injection and basal bark treatment.

Foliar Application

Foliar applications involve applying herbicide directly to the leaves and stems of target plants. An adjuvant or surfactant is often needed to enable the herbicide to penetrate the plant cuticle. There are several types of foliar application tools available, including spot applicators, wick applicators, and boom applicators. Foliar applications are usually most effective when applied from midsummer to late fall, although spring and winter applications can be useful for specific plants and situations (Miller 2003).

Cut-Treat

This method is often used on woody species that typically re-sprout after being cut. Cut-treat involves applying herbicide to the entire inner bark (cambium) of freshly cut stumps within 5-10 minutes after the trunk or stem is cut. Herbicide can be applied to cut stumps in many ways, including spray and squirt bottles, backpack sprayer, wick, or even paint brushes. It allows for a great deal of control over the site of herbicide application, and consequently, has a low probability of impacting non-target species or contaminating the environment. It also requires only a small amount of herbicide to be effective. The most effective time of the year for the cut-

treat method is summer through late winter (as long as the ground is not frozen). Heavy spring sap flow can wash herbicide from cuts, making this an ineffective period to use this method.

Stem Injection

Stem injection (including hack-and-squirt) is a selective method of controlling larger trees and shrubs with minimum damage to non-target plants. It requires cuplike downward incisions spaced around the trunk with a measured amount of herbicide applied into each of the incisions. Special tree injectors (such as the EZ-Ject Lance) are available to perform this procedure, or a sharp knife, saw, ax, or power drill along with a squirt bottle of herbicide can be used in sequence to perform the hack-and-squirt method.

Basal Bark

Basal bark treatments are effective in controlling woody stems less than about 6 inches in diameter, before bark becomes thick and corky. This method involves applying a 6 to 12 inch band of an herbicide-oil mixture around the circumference of the trunk of the target plant, approximately one foot above ground. The herbicide can be applied with a backpack sprayer or a wick applicator. Applications are generally done in late winter and early spring, when leaves do not hinder spraying the trunk.

The following are management prescriptions for those exotic plants found on Standing Stone State Forest which are listed as a “Severe Threat.” These prescriptions have been assembled from various weed control manuals, published research results and web sites cited at the back of this document.

Ailanthus altissima (tree-of-heaven)

A variety of control methods have proven effective in controlling the spread of tree-of-heaven. Young seedlings can be effectively controlled by hand pulling. Mechanical control such as cutting with a power or manual saw can serve as an initial control measure to prevent seed production. However, success will most likely require either selective herbicide application or repeated cuttings for re-sprouts (Hoshovsky 1988).

Herbicidal controls including foliar spray, cut-treat, stem injection, and basal bark application have proven effective in controlling more mature tree-of-heaven. The foliar spray method should only be considered for large thickets of ailanthus seedlings where risk to non-target plants is minimal. Apply a 2% solution of either glyphosate (brand names include: Roundup, Rodeo, Accord) and water or triclopyr (brand names include: Garlon, Pathfinder) and water, plus a non-ionic surfactant, to thoroughly wet all leaves (Southeast Exotic Pest Plant Council 1997). Glyphosate is a non-selective systemic herbicide that may kill non-target plants if accidentally sprayed. Triclopyr is a selective herbicide for broadleaf species and may be used in areas where desirable grasses are growing without non-target damage.

The cut-treat and stem injection methods should be considered when treating large individual trees where the presence of desirable species precludes foliar application. In each case, apply a 50% solution of either glyphosate and water or triclopyr and water to the freshly cut stump or stem. If using the basal bark method, apply a mixture of 25% triclopyr and 75% horticultural oil to the basal parts of the tree (Hoshovsky 1988). Thorough wetting is necessary for good control.

Albizia julibrissin (mimosa)

Mimosa can be effectively controlled by manual removal of young seedlings. Plants should be pulled as soon as they are large enough to grasp, but before they produce seeds. For

large thickets of mimosa seedlings where risk to non-target species is minimal, foliar application of glyphosate or triclopyr can be made. Apply a 2% solution of either glyphosate or triclopyr and water plus a 0.5% non-ionic surfactant to thoroughly wet all leaves (Tennessee Exotic Pest Plant Council 1997). Applications are most effective when conducted between July and October.

When treating individual trees or where the presence of desirable species precludes foliar application, the cut-treat or stem injection methods should be considered. Stump treatments can be used as long as the ground is not frozen. Cut the stems at or near ground level and immediately apply a 50% solution of glyphosate or triclopyr and water to the cut stump. For larger trees, make stem injections (anytime except April and May) using Arsenal AC or Garlon3A in dilutions as specified on the herbicide label (Miller 2003).

The basal bark method is also effective throughout the year as long as the ground is not frozen. Apply a mixture of 25% triclopyr and 75% horticultural oil to the basal parts of the tree to a height of 30-38 cm from the ground. Thorough wetting is necessary for good control.

Elaeagnus umbellata (Russian olive)

A large Russian olive patch was found in a disturbed wetland near the headwaters of Mill Creek. Russian olive can be effectively controlled by manual removal of young seedlings. Care must be taken to remove the entire root since broken fragments may resprout. Seedlings are best pulled after a rain when the soil is loose.

The foliar spray method should be considered for large patches of Russian olive seedlings where risk to non-target species is minimal (April to October). Thoroughly wet all leaves with a 2% solution of glyphosate or triclopyr and water plus a 0.5% non-ionic surfactant (Tennessee

Exotic Pest Plant Council 1997). A 1% solution of Arsenal or Vanquish in water has likewise proven effective in controlling seedlings and small shrubs (Miller 2003).

The cut stump and basal bark methods used to control tree-of-heaven and mimosa can also be used to effectively control Russian olive. Refer to methods described above.

Euonymus fortunei (winter creeper)

Winter creeper was documented at only one location on the State Forest and was effectively removed by hand pulling. Should other populations be documented elsewhere on the Forest, where practical, individual vines should be pulled up by the roots and removed from the area by hand. In areas of heavy infestation, vines should be cut by hand or by brush-blade and cut stems sprayed with 20% solution of glyphosate in water with a surfactant (Hutchinson 1990). Other herbicides documented to be effective in controlling winter creeper include Garlon 4 as a 2% solution in water and picloram (tradename Tordon K) as a 2% solution (Miller 2003).[20] For spot treatment, individual stems can be painted by hand using a sponge applicator. Treatment should take place between July and October for successive years.

Lespedeza cuneata (sericea lespedeza)

Lespedeza was observed growing along disturbed roadsides, fields and food plot areas. At present, the best control of lespedeza combines both mechanical and chemical treatments. Hand pulling is impractical due to its extensive perennial root system, but mowing plants in the bud stage for two or three consecutive years, may reduce vigor of lespedeza stands and control further spread. Plants should be cut before seeds mature (Stevens 2002). Mowing followed by an herbicide application is likely the most effective option for the successful control of lespedeza.

[20] Tordon heribicides are Restricted Use Pesticides. When using Tordon, rainfall must occur within 6 days after application for needed soil activation. Nontarget plants may be injured or killed by root uptake.

Herbicidal controls have proven effective as long as the plants are actively growing. Foliar applications of glyphosate, triclopyr and metsulfuron (tradename Escort), plus a non-ionic surfactant, are effective in controlling lespedeza. Apply a 2% solution of glyphosate or triclopyr mixed with water. Metsulfuron should be applied at a rate of 0.3g/gallon of water (Tennessee Exotic Pest Plant Council 1997).

Ligustrum sinense (Chinese privet)

Privet was found in one location at Standing Stone in a disturbed cedar-dominated forest[21]. Although privet may occur elsewhere on the State Forest or nearby private property, the eradication of this small population will likely reduce the spread of this pest. Manual and mechanical treatments of privet including hand pulling, mowing and cutting are appropriate methods for controlling young seedlings and small initial populations or for use in environmentally sensitive areas where herbicide cannot be used. As is the case with many invasives, mowing and cutting will control the spread of privet but will not eradicate it.

The use of goats to graze privet has also been documented as an effective method for controlling this exotic by the Tennessee Chapter of The Nature Conservancy. This method works best in young privet stands that the goats can successfully reach and destroy.

The following chemical treatments have also proven effective in controlling privet: foliar spray, cut-treat and basal bark (Tennessee Exotic Pest Plant Council 1997). In higher quality areas of the State Forest, it is suggested that the cut-treat method be used to treat privet, applying a 25% solution of glyphosate or triclopyr and water to the cut stump to minimize risk to non-target species in the area.

[21] GIS point 232 documents this location.

Lonicera x *bella* (bush honeysuckle)

Bush honeysuckle was documented at only one small site on the state park and subsequent collection of this plant as a state record removed the reproductive stems. However, the plant still exists and should be eradicated. Should bush honeysuckle be found elsewhere on the Park or Forest, immediate attention should be given to its eradication. If bush honeysuckle is controlled at this initial stage, TDF will undoubtedly benefit from the time, energy and cost savings associated with early detection and management.

Manual and mechanical methods proven effective in controlling juvenile plants or small initial populations respectively include pulling, grubbing and cutting. Mechanical management typically requires repeated treatments for a period of three to five years to control the respouts. Repeated annual prescribed burns during the growing season have also been shown to top-kill shrubs and inhibit new shoot production. Because exotic bush honeysuckle readily resprouts, it may be necessary to re-burn every year or every other year for several years.

Many land managers report that treatment with herbicides is necessary to control bush honeysuckle. Water soluble formulations of glyphosate or triclopyr can be used as foliar sprays or cut-stump treatments. Foliar applications should take place late in the growing season, and cut-stump applications from late summer through the dormant season (Batcher and Stiles 2000). Use a 2% solution of glyphosate or triclopyr for foliar applications and a 20-25% solution for cut-stump treatments.

Lonicera japonica (Japanese honeysuckle)

Hand pulling can be a practical method to remove small patches of seedlings. Pulling has proven most effective when conducted during the winter months. This method greatly reduces spraying requirements. For larger infestations, the most effective control of Japanese honeysuckle combines prescribed fire and herbicides. Late autumn or winter burns can be used

to reduce Japanese honeysuckle biomass when most native species are dormant. Resprouts can then be treated with a foliar application of herbicide about a month after they emerge. Apply a 1.5% solution of glyphosate. If using herbicide as the sole method for controlling Japanese honeysuckle, applying herbicide shortly after the first killing frost, but before the first hard frost, appears to be the most effective treatment (Nuzzo 1997).

Microstegium vimineum (Nepalese grass)

For small infestations, manual or mechanical techniques may be the best method for controlling Nepalese grass, since it is a shallow-rooted annual. Hand pulling, however, is extremely labor-intensive, and will need to be repeated for at least seven years to exhaust the seed bank. Mowing may be an effective technique for controlling the spread if carried out in late summer, when the plants are in peak bloom but before seed is produced.

For larger infestations, systemic herbicides such as glyphosate or imazameth (tradename Plateau) or grass-specific herbicides like sethoxydim (tradename Vantage or Post) may be effective (Tu 2001). Of these, imazameth (applied at a rate of 6 ounces per acre) seems to be the herbicide of choice for many land managers since it kills *microstegium* but allows the development of native sedges and broadleaf plants.

Paulownia tomentosa (princess tree)

Follow treatment regime prescribed for tree-of-heaven and mimosa. As with other exotics, it is important to target the small, outlying infestations first.

Rosa multiflora (multiflora rose)

Mowing/cutting of multiflora rose is appropriate for small initial populations or for environmentally sensitive areas where herbicide cannot be used. Repeated mowing or cutting

will control the spread of multiflora rose, but will not eradicate it (Tennessee Exotic Pest Plant Council 1997).

Depending on the size of infestation, individual bush size and presence of desirable species, the following herbicide methods can be used to control multiflora rose: foliar spray, cut-treat, and basal bark. Follow chemical treatments prescribed for the control of tree-of-heaven and mimosa.

Conclusion

The ecological inventory at Standing Stone State Forest is an excellent example of the primary role for which Heritage programs were originally conceived. The opportunity to generate and synthesize field data from different scientific disciplines over such a remarkable natural resource has been a great benefit to DNH. The burgeoning partnership with TDF compliments DNH's mission well, and future opportunities are welcomed.

Beyond a doubt, creation of the State Park and Forest through private land purchases in the 1930s- and their subsequent transfer to the TDF in the 1950s- was a pivotal and prudent investment. Certainly the significance of its acquisition could not have been fully appreciated at the time. The State Forest provides an excellent example of the deciduous forests of the eastern United States and the great display of spring wildflowers cannot be over stated. This public land is a key refuge and preserve for native plant and animal species and assemblages. Likewise, the myriad of habitats at Standing Stone provide for an incalculable diversity of invertebrates.

The karst topography provides a remarkable contrast to rich slopes and deep, mature forests. The subterranean environs of the State Forest- though often tedious to access or navigate- add a level of complexity to the ecology that may be lost to the casual observer. To fully explore the attributes of the karst systems of the State Forest, TDF may wish to actively

pursue partnerships with TCS and other conscientious cave explorers to acquire better knowledge of this resource.

Although additional surveys will yield more information, this report affords TDF a better understanding of the State Forest's biota. DNH encourages TDF to continue the promotion of novel ecological research, particularly in those disciplines not fully represented in the current study. With the numerous fascinating habitats contained on the property, Standing Stone is a fitting place for students and researchers alike. Formal arrangements with area universities and researchers would not only better TDF's understanding of its land base, but would provide the academic community greater insight into the multiple roles TDF has as steward of Tennessee's state forests. Clearly these mutual goals are in the public interest.

In addition to the value of the State Forest for timber production, academic research, and as a refuge for numerous plants and animals, it is most certainly a place of beauty and serenity. This benefit should never be underestimated as Tennessee residents seek places to safely enjoy outdoor recreation. TDF has a challenge to find the tools and means to balance appropriate public access with the other foci that drive management practices in this area. The DNH hopes that the management recommendations will compliment this process, and help preserve the many values of the State Forest for future generations.

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Table 1. Major Soil Types of Standing Stone State Forest.

Soil Type	Parent Material	Landscape Position	Surface Layer Depth	Drainage	Soil Reaction
Etowah silt loam	Alluvium	Terrace	0 to 5 inches	Well drained	Strongly acid to very strongly acid
Minvale gravelly loam	Colluvium or alluvium underlain by limestone residuum	Lower side slopes and benches	0 to 5 inches	Well drained	Very strongly acid or strongly acid
Nella-talbott-rock outcrop complex	Sandstone and limestone	Mountains and hills	0 to 3 inches	Well drained	Very strongly acid or strongly acid
Garmon-newbern complex	Shale residuum	Slopes of ravines and streams	Shallow to moderately deep	Well drained to somewhat excessively drained	Not listed
Sengtown gravelly silt loam	Residuum from cherty limestone	Hills	0 to 15 inches	Well drained	Very strongly acid or strongly acid
Hawthorne gravelly silt loam	Residuum from cherty limestone	Ridges and side hillsides	0 to 4 inches	Somewhat excessively drained	Very strongly acid or strongly acid
Christian loam	Residuum from siltstone, limestone, and sandy limestone	Ridges and hillsides	0 to 8 inches	Well drained	Strongly acid or very strongly acid
Faywood-hawthorne complex	Residuum weathered from limestone and siltstone bedrock	Hills and ridges	0 to 6 inches	Well drained	Strongly acid in the upper part and ranges to slightly acid near bedrock

Soil Type	Parent Material	Landscape Position	Surface Layer Depth	Drainage	Soil Reaction
Talbott-rock outcrop	Limestone residuum	Low hills and ridgetops	0 to 5 inches (with some rock ledges up to 10 feet)	Well drained	Moderately acid or strongly acid, except the layer just above bedrock ranges to neutral
Guthrie silt loam (wetland)[22]	Loess and alluvium	Depressions	0-4 inches	Poorly drained	Very strongly acid to strongly acid
Lily loam	Residuum from sandstone	Ridgetops	0 to 3 inches	Well drained	Strongly acid or very strongly acid
Lonewood loam[23]	Residuum from sandstone and shale	Ridges and hillsides	0 to 4 inches	Well drained	Strongly or very strongly acid
Bouldin very cobbly loam[24]	Colluvium	Hillsides	0 to 7 inches	Well drained	Strongly or very strongly acid

Modified from United States Department of Agriculture, Natural Resources Conservation Service (2004).

[22] This type is found in the depressional wetland on Highway 292/Baptist Ridge Road.
[23] This soil is found atop Cooper Mountain on the Hilham Quadrangle.
[24] At Standing Stone, this type is only found in one large steep forested depression.

Table 2. Plants from Standing Stone State Forest, 2004

Frequency of Occurrence Definitions

Very Rare – A single locality, few individuals
Rare – One or two localities, generally small populations
Scarce – Several localities or scattered small populations
Infrequent – Scattered localities throughout
Occasional – Well distributed but no where abundant
Frequent – Generally encountered
Common – Characteristic and dominant

Scientific Name	Common Name	Habitat(s)	Frequency	Exotic	County Record	Collected	Season
Acalypha virginica	copperleaf	clear cut	scarce		x	x	sum
Acer negundo	boxelder	floodplain forests	infrequent		x	x	spr
Acer rubrum	red maple	mesic forests	occasional				spr
Acer saccharum	sugar maple	mesic forests	common		x	x	spr
Actaea pachypoda	doll's eyes	mesic forests	occasional				spr
Adiantium pedatum	maidenhair fern	mesic forests	infrequent				spr
Aesculus flava	yellow buckeye	mesic forests, floodplain terraces	occasional				spr
Agalinis tenuifolia	slenderleaf false foxglove	dry rocky ridge outcrops	very rare				sum
Agrimonia pubescens	soft agrimony	dry limestone forests	infrequent				sum
Agrimonia rostellata	beaked agrimony	dry woods	occasional		x		sum
Ailanthus altissima	tree of heaven	roadsides, forests, disturbed areas	frequent	x	x	x	sum
Albizia julibrissin	mimosa	open powerline ROW	infrequent	x	x		sum
Alisma subcordatum	American water plantain	wet areas along haul road	scarce		x	x	sum
Allium burdickii	narrowleaf ramps	mesic forests and floodplains	scarce		x	x	spr
Allium cernuum	ramps	mesic forests	scarce				fall
Ambrosia trifida	giant ragweed	roadside	occasional		x	x	sum
Amphicarpaea bracteata	American hog peanut	moist-mesic floodplains, roadsides	frequent				sum
Andropogon gerardii	big bluestem	warm season grassland (managed)	rare				sum
Anemone quinquefolia	wood anemone	floodplain	rare				spr
Anemone virginiana	tall thimbleweed	disturbed roadsides, dry forests	infrequent				sum

Scientific Name	Common Name	Habitat(s)	Frequency	Exotic	County Record	Collected	Season
Antennaria plantaginea	pussytoes	dry forests	infrequent				spr
Antennaria solitaria	singlehead pussytoes	dry forests and trailsides	scarce		x	x	spr
Aplectrum hymenale	puttyroot orchid	dry-mesic forests	occasional				sum
Aquilegia canadensis	columbine	dry limestone outcroppings	infrequent		x		spr
Arabis laevigata	smooth rock cress	dry-mesic rock outcrops	occasional				spr
Aralia racemosa	American spikenard	mesic forests	rare		x		sum
Aralia spinosa	devil's walking stick	roadsides	frequent				sum
Arisaema dracontium	green dragon	mesic forests	infrequent				spr
Arisaema triphyllum	Jack in the pulpit	mesic forests	frequent				spr
Aristolochia macrophylla	Dutchman's pipe	limestone outcrops mesic forest	rare		x	x	spr
Aristolochia serpentaria	Virginia snakeroot	dry forests	infrequent		x	x	spr
Arundinaria gigantea	giant cane	floodplain	infrequent				spr
Asarum canadense	wild ginger	mesic forests and floodplains	infrequent				spr
Asclepias syriaca	common milkweed	disturbed roadsides/powerline row	infrequent				sum
Asimina triloba	pawpaw	floodplain forests, mesic slopes	infrequent				spr
Asplenium platyneuron	ebony spleenwort	mesic forests, boulders	occasional				spr
Asplenium resiliens	blackstem spleenwort	dry karst forest	scarce				spr
Asplenium rhizophyllum	walking fern	moist limestone boulders and outcroppings	occasional				spr
Aster divaricatus	white wood aster	mesic woods	infrequent				spr
Aster lateriflorus	calico aster	disturbed openings	infrequent				fall
Aster shortii	Short's aster	dry forests	scarce				sum
Athyrium felix-femina ssp. asplenioides	asplenium lady fern	alluvial woods	infrequent				spr
Aureolaria virginica	downy yellow false foxglove	dry slopes and ridges	infrequent		x	x	sum
Berberis thunbergii	Japanese barberry	floodplain forest	rare	x	x	x	spr
Bidens bipinnata	Spanish needles	dry forests	infrequent		x		sum
Bignonia capreolata	crossvine	mesic-dry slopes	infrequent				spr
Botrychium dissectum	cutleaf grape fern	moist-mesic forests	scarce				spr
Botrychium virginianum	rattlesnake fern	mesic forests	occasional				spr
Brachyelytrum erectum	bearded shorthusk	mesic-dry forests	occasional		x	x	spr
Brassica rapa	field mustard	forestry roadside	occasional	x			spr
Bromus pubescens	hairy woodland brome	mesic forests	occasional				sum
Cacalia atriplicifolia	pale Indian plaintain	mesic forests and floodplains	infrequent				sum
Cacalia muehlenbergii	great Indian plaintain	mesic or floodplain forests	infrequent		x		sum
Carex albicans var. albicans	whitetinge sedge	dry-mesic forests	infrequent		x	x	spr

Scientific Name	Common Name	Habitat(s)	Frequency	Exotic	County Record	Collected	Season
Carex blanda	eastern woodland sedge	mesic floodplain	occasional			x	spr
Carex frankii	Frank's sedge	wet areas along haul road	scarce			x	spr
Carex hirsutella	fuzzy wuzzy sedge	successional woodland (pine/cedar)	infrequent			x	spr
Carex plantaginea	plantainleaf sedge	mesic slope forests/floodplains	occasional		x	x	spr
Carex striatula	lined sedge	mesic slopes	infrequent			x	spr
Carex styloflexa	bent sedge	disturbed forests	infrequent		x	x	spr
Carex typhina	cattail sedge	depressional wetland	scarce			x	sum
Carex virescens	ribbed sedge	mesic-dry forest	infrequent		x	x	spr
Carex willdenowii	Wildenow's sedge	dry slopes and ridges	infrequent				spr
Carpinus caroliniana	blue beech	floodplains	scarce		x		spr
Carya glabra	pignut hickory	dry ridges and slopes	occasional				spr
Carya ovata var. australis	southern shagbark hickory	dry-mesic hickory forests	occasional				spr
Carya tomentosa	mockernut hickory	oak-hickory/hickory dominated forests	occasional		x	x	sum
Cassia sp (marilandica?) veg.	Maryland senna	dry-mesic knob	rare		x		sum
Castanea dentata	American chestnut	dry ericaceous forest	scarce		x	x	spr
Caulophyllum thalictroides	blue cohosh	mesic forests and floodplains	occasional				spr
Celtis occidentalis	hackberry	successional forests	rare				spr
Cerastium nutans	nodding chickweed	mesic floodplains	infrequent		x	x	spr
Cercis canadensis	redbud	dry woods, roadsides	frequent				spr
Chaerophyllum tainturieri	hairyfruit chervil	floodplains/ruderal sites	occasional		x	x	spr
Chamaecrista fasciculata	partridge pea	disturbed areas	occasional			x	sum
Chamaesyce nutans	eyebane	roadsides	infrequent		x	x	sum
Chimaphila maculata	spotted wintergreen	dry upland forests	occasional				spr
Chrysopsis camporum	lemon yellow false golden aster	roadsides	infrequent				sum
Cimicifuga racemosa	black cohosh	mesic forests	infrequent				spr
Circaea lutetiana v. canadensis	broadleaf enchanter's nightshade	mesic forests	infrequent				spr
Cirsium discolor	field thistle	roadsides	scarce		x	x	sum
Cladrastis kentuckea	Kentucky yellowwood	mesic forests	occasional				spr
Claytonia caroliniana	Carolina spring beauty	wooded floodplains	occasional		x	x	spr
Claytonia virginiana	Virginia spring beauty	mesic forests	frequent				spr
Clematis virginiana	devil's darning needles	disturbed areas/mesic forests	occasional				sum
Conoclinium coelestinum	blue mistflower	trails, forests	occasional			x	sum
Conopholis americana	American squawroot	mixed oak woods	occasional		x	x	spr
Conyza canadensis	horseweed	clear cut	infrequent		x	x	sum
Corallorrhiza odontorhiza	autumn coralroot	mesic forests	very rare		x	x	fall

Scientific Name	Common Name	Habitat(s)	Frequency	Exotic	County Record	Collected	Season
Coreopsis major	greater tickseed	dry forests	occasional				sum
Cornus drummondii	rough leaf dogwood	dry forests	infrequent		x		spr
Cornus florida	flowering dogwood	dry-mesic forests	occasional		x	x	spr
Corydalis flavula	yellow fumewort	mesic forests	occasional				spr
Croton monanthogynous	prairie tea	roadside	scarce				sum
Cryptotaenia canadensis	Canadian honewort	mesic, shaded forests	occasional		x		spr
Cynoglossum virginianum	wild comfrey	mesic-dry forest	occasional				spr
Cyperus strigosus	strawcolored flat sedge	clear cut	infrequent		x	x	sum
Cystopteris protrusa	lowland bladderfern	mesic forests with limestone	infrequent				sum
Danthonia spicata	poverty oat grass	dry woods	infrequent		x	x	spr
Delphinium tricorne	dwarf larkspur	floodplain or mesic slope forests	frequent				spr
Dentaria diphylla	crinkleroot	moist forests and seeps	infrequent				spr
Dentaria heterophylla	slender toothwort	floodplains/mesic forests	occasional				spr
Dentaria lacinata	cutleaf toothwort	mesic-dry forests	frequent				spr
Dentaria multifida	forkleaf toothwort	mesic forests	infrequent				spr
Desmodium glutinosum	pointed leaf tick trefoil	dry-mesic forests	infrequent				fall
Desmodium nudiflorum	naked flower tick trefoil	mesic forests	occasional				fall
Desmodium paniculatum	panicled leaf tick trefoil	open mesic-dry forests	infrequent				fall
Desmodium rotundifolium	prostrate tick trefoil	dry forests, ridge tops.	infrequent		x	x	fall
Desmodium viridiflorum	velvetleaf tick trefoil	edge of disturbed area	infrequent		x	x	sum
Diarrhena americana	American beakgrain	successional moist limestone forests	infrequent				sum
Dicanthelium boscii	Bosc's panic grass	mesic forests	infrequent				spr
Dicanthelium commutatum	variable panic grass	mesic-dry forest	occasional				spr
Dicanthelium dichotomum	cypress panic grass	mesic forests, wet ditches	occasional				spr
Dicanthelium leucothrix	rough panic grass	mesic-dry forest	infrequent		x	x	spr
Dicanthelium polyanthes	roughseed panic grass	disturbed areas, logging road through clear cut	infrequent		x	x	sum
Dicentra cucullaria	Dutchman's breeches	mesic forests	occasional		x		spr
Dichanthelium clandestinum	deertongue	Moist ground, alluvial terraces	infrequent		x	x	sum
Dioscorea villosa	wild yam	mesic forests and floodplains	occasional		x	x	spr
Diospyros virginiana	persimmon	dry ridges, dry-mesic forests	occasional		x		spr
Diphasiastrum digitatum	fan clubmoss	floodplain forests	scarce		x	x	spr
Diplazium pycnocarpon	glade fern	mesic forests and floodplains	infrequent		x		spr
Dirca palustris	leatherwood	floodplain forests	occasional				spr

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Disporum lanuginosum	yellow fairybells	mesic slopes	occasional				spr
Disporum maculatum	spotted mandarin	mesic slopes	scarce		x		spr
Dodecatheon meadia	shooting star	dry slopes/ridges	frequent				spr
Doellingeria infirma	cornel leaf whitetop	dry cedar-oak forest	infrequent		x	x	sum
Echinochloa muricata var. muricata	barnyard grass	clear cut	infrequent		x	x	sum
Elaeagnus umbellata	Russian olive	old home sites/TWRA foodplots, disturbed wetland	infrequent	x	x	x	spr
Elephantopus carolinianus	Carolina elephant's foot	forests	infrequent			x	sum
Elymus villosus	hairy wild rye	dry-mesic forests	infrequent		x	x	spr
Enemion biternatum	false rue anemone	rich slopes	very rare		x	x	spr
Epifagus virginiana	beechdrops	mixed beech forests	occasional		x	x	spr
Epigea repens	trailing arbutus	sandstone/cherty forests	infrequent				spr
Equisetum arvensis	field horsetail	floodplains	rare				spr
Erigenia bulbosa	harbinger of spring	mesic forests	occasional				spr
Erigeron philadelphicus	Philadelphia feabane	old road bed, roadsides	occasional		x	x	spr
Erigeron pulchellus	robin's plantain	dry slopes, ridges	infrequent				spr
Erythonium americanum	dogtooth violet	floodplains/mesic forests	frequent		x	x	spr
Euonymous fortunei	winter creeper	disturbed woods	rare	x	x	x	spr
Euonymus americanus	strawberry bush	floodplains/mesic forests	infrequent				spr
Euonymus atropurpureus	eastern wahoo	dry-mesic knob	rare		x	x	spr
Eupatorium altissima	tall thoroughwort	riparian forests	infrequent			x	fall
Eupatorium hyssopifolium	hyssopleaf thoroughwort	open meadow	infrequent				sum
Eupatorium purpureum	joe pye weed	floodplain	infrequent		x	x	sum
Euphorbia commutata	tinted woodland spurge	mesic forests	infrequent				spr
Euphorbia corollata	flowering spurge	dry, open disturbed sites	infrequent				sum
Euphorbia mercurialina	mercury spurge	dry slope forests	infrequent				spr
Fagus grandifolia	American beech	mesic forests	common		x	x	spr
Festuca subverticillata	nodding fescue	dry-mesic forests	rare				spr
Fraxinus americana	white ash	forests	frequent		x	x	spr
Fraxinus quadrangulata	blue ash	mesic/floodplain forests, dry ridges	infrequent				spr
Galactia volubilis	milk pea	eroded clay roadbank	scarce		x	x	sum
Galearis spectabilis	showy orchid	mesic floodplain of upper Bryan's Fork	very rare		x	x	spr
Galium aparine	cleavers	floodplains and successional forests	occasional		x		spr

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Galium circaezans	licorice beadstraw	mesic forests	occasional				spr
Galium lanceolatum	lanceleaf wild licorice	dry forests	infrequent		x		spr
Galium parisiense	wall beadstraw	successional floodplain	very rare	x	x	x	sum
Galium triflorum	fragrant beadstraw	mesic forests	occasional				sum
Geranium maculatum	wild geranium	mesic forests	occasional				spr
Geum canadense	white avens	mesic forests	infrequent				sum
Geum vernum	spring avens	mesic forests	occasional				spr
Glyceria striata	fowl manna grass	streamside seep	rare				sum
Gnaphalium obtusifolium	rabbit tobacco	warm season grass meadow	infrequent		x	x	sum
Gratiola neglecta	clammy hedge hyssop	puddle in logging road	rare				sum
Gymnocladus diocus	Kentucky coffee tree	successional forests, mesic slopes	scarce		x	x	sum
Hamamelis virginiana	witch hazel	floodplain forests/dry ridges	occasional				spr
Helenium flexuosum	purplehead sneezeweed	dry edges of haul road	scarce				sum
Helianthus microcephalus	small woodland sunflower	dry roadsides, trails, haul roads	occasional				sum
Hepatica acutiloba	liverleaf/sharplobe hepatica	mesic forests	frequent				spr
Heuchera americana	American alumroot	rock outcroppings	infrequent				spr
Heuchera parviflora	littleflower alumroot	rock outcroppings	rare		x	x	sum
Heuchera villosa	hairy alumroot	rock outcroppings	infrequent				sum
Hexalectris spicata	spiked crested coralroot	dry karst forest	very rare		x	photo	sum
Hieracium gronovii	queendevil	roadbanks, margins of pine plantations	infrequent				sum
Houstonia caerulea	azure bluet	mesic forests	occasional				spr
Houstonia purpurea var. calycosa	Venus' pride	limestone outcrops	very rare		x	x	spr
Houstonia purpurerea var.pur.	Venus' pride	mesic forests, trails	occasional				spr
Huperzia lucidulum	shining clubmoss	pine clear cut	infrequent		x	x	spr
Hybanthus concolor	green violet	mesic forests	infrequent				spr
Hydrangea arborescens	hydrangea	limestone seep-bluffs, steep stream banks	common				spr
Hydrastis canadensis	goldenseal	rich floodplain and slope forests	very rare				spr
Hydrophyllum canadense	bluntleaf waterleaf	rich floodplains	occasional				spr
Hypericum frondosum	cedarglade St. Johnswort	dry karst forest	occasional				spr
Hypericum mutilum	dwarf St. Johnswort	wet areas along haul road	scarce				sum
Hypericum punctatum	spotted St. Johnswort	dry woods, roadsides	infrequent				sum
Hypericum stragalum	St. Andrew's cross	dry, open disturbed sites and forests	occasional				sum

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Ilex opaca	American holly	dry slopes, mesic forests	scarce				spr
Impatiens capensis	jewelweed	seeps, stream sides and moist roadsides	occasional				sum
Impatiens pallida	pale touch-me-not	wet roadsides (in State Park)	very rare		x	x	sum
Ipomea pandurata	wild potato vine	warm season grassland (managed)	infrequent				sum
Iris cristata	dwarf crested iris	dry-mesic forests	occasional				spr
Jeffersonia diphylla	twinleaf	mesic forests and slopes	frequent		x	x	spr
Juglans cinerea	white walnut/butternut	mesic slope forests/floodplains	scarce				spr
Juglans nigra	black walnut	mesic forests	occasional		x	x	spr
Juncus diffusissimus	slimpod rush	wet sections of logging road	very rare		x	x	spr
Juncus effusus	common rush	wet sections of logging road	infrequent		x	x	spr
Juncus marginatus	grassleaf rush	wet sections of logging road	infrequent		x	x	spr
Juniperus virginiana	eastern red cedar	dry-mesic and karst forests	frequent		x	x	spr
Krigia biflora	twoflower dwarf dandelion	dry slopes and ridges	infrequent				spr
Lamium amplexicaule	henbit	disturbed trails, roadsides, and forests; floodplains	infrequent	x	x	x	spr
Lamium purpureum	dead nettle	disturbed roadsides	occasional	x	x	x	spr
Laportea canadensis	wood nettle	mesic forests, floodplains	frequent		x		sum
Lepidium campestre	field pepperweed	disturbed roadside and roadbeds	infrequent	x	x	x	spr
Lespedeza capitata(?)	roundhead lespedeza	dry, open disturbed sites	infrequent				sum
Lespedeza cuneata	Chinese lespedeza	dry roadsides, food plots	frequent	x	x		sum
Lespedeza procumbens	trailing lespedeza	dry edges of forests and roads	occasional				sum
Lespedeza virginica	slender lespedeza	dry forest	infrequent				sum
Ligusticum canadense	loveage	mesic forests and wet ditches	infrequent				sum
Ligustrum sinense	Chinese privet	successional woods	rare	x	x	x	spr
Lindera benzoin	spicebush	floodplain forests/lower mesic slopes	frequent				spr
Linum striatum	ringed yellow flax	dry edges of haul road	scarce				sum
Liquidambar styraciflua	sweetgum	floodplain forests/lower mesic slopes	infrequent				spr
Liriodendron tulipifera	tulip tree	mesic forests, logged areas	common				spr
Listera australis	southern twayblade	wet forested depression	very rare		x	photo	spr
Lithospermum canescens	hoary puccoon	dry shaley outcroppings	scarce		x	x	spr
Lithospermum tuberosum	tuberous stoneseed	dry slopes and ridges	occasional				spr
Lobelia inflata	Indian tobacco	dry roadsides, trails, haul roads	infrequent				sum

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Lonicera japonica	Japanese honeysuckle	forests, ruderal sites, clearcuts	common	x	x	x	sum
Lonicera x bella	Bell's honeysuckle	rocky floodplain	very rare	x	x	x	spr
Luzula multiflora	common woodrush	trails, forests	frequent		x		spr
Lycopus virginicus	Virginia water horehound	wetland	scarce				sum
Magnolia acuminata	cucumber tree	mesic slope forests/floodplains	occasional				spr
Magnolia tripetala	umbrella magnolia	mesic forests	infrequent				spr
Manfreda virginica	false aloe	dry karst oak-hickory forests	very rare		x	x	sum
Matelea sp. (veg)	milkvine	rock forests	infrequent				spr
Menispermum canadense	common moonseed	mesic forests	infrequent		x		sum
Mertensia virginica	Virginia bluebells	floodplains	infrequent		x		spr
Microstegium vimenium	Nepalese browntop	disturbed trails, roadsides, and forests; floodplains	common	x	x	x	sum
Mitchella repens	partridge berry	dry-mesic forests	infrequent				spr
Mitella diphylla	bishop's cap	stream side seeps	infrequent				spr
Monarda clinopoda	white bergamot	dry forests, roadsides	occasional				sum
Monotropa hypopithys	pinesap	dry ericaceous forest	rare		x	x	sum
Morus rubra	red mulberry	roadsides, ruderal sites	infrequent				spr
Nyssa sylvatica	blackgum	dry slopes and ridges	frequent				spr
Obolaria virginica	Virginia pennywort	dry-mesic forests	occasional				spr
Osmorhiza claytonii	Clayton's sweet cicely	mesic slopes/floodplains	occasional		x		spr
Osmorhiza longistylis	longstyle sweet cicely	floodplains	infrequent				spr
Ostrya virginiana	hopehornbeam/ironwood	dry slopes and ridges	infrequent		x	x	spr
Oxalis grandis	great yellow wood sorrel	mesic slopes	infrequent				spr
Oxydendrum arboreum	sourwood	disturbed cherty/sandstone forests	infrequent				sum
Oxypolis rigidior	stiff cowbane	depressional wetland	rare				sum
Pachysandra procumbens	Allegheny spurge	mesic forests	frequent				spr
Panax quinquefolius	ginseng	mesic forests	scarce		x		spr
Panicum anceps	beaked panic grass	dry, open disturbed sites	occasional		x	x	sum
Panicum flexile	wiry panic grass	edge of clear cut, disturbed areas	infrequent			x	sum
Panicum virgatum	switch grass	warm season grassland (managed)	rare				sum
Parthenocissus quinquefolius	Virginia creeper	mesic-dry-floodplain forests throughout	common		x		spr
Paspalum laeve	field paspalum	Glascock cemetary	infrequent		x	x	sum
Passiflora lutea	yellow passion flower/maypops	disturbed roadsides, dry forests	infrequent				sum

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Paulownia tomentosa	princess tree	roadsides	infrequent	x	x		spr
Pellaea atropurpurea	purple cliffbreak fern	limestone boulders and outcroppings	occasional				spr
Penstemon canescens	eastern gray beard tongue	dry woods	infrequent				sum
Penthorum sedoides	ditch stonecrop	wet ditches	rare				sum
Perilla frutescens	beefsteak plant	roadsides	occasional	x	x	x	sum
Phacelia bipinnatifida	purple phacelia	mesic forests and forested floodplains	frequent				spr
Phegopteris hexagonoptera	broad beech fern	dry-mesic forests	occasional				spr
Philadelphus hirsutus	Cumberland mock orange	steep rocky slopes along creeks	scarce				spr
Phlox divaricata	wild blue phlox	mesic forests	occasional				spr
Phoradendron leucarpum	mistletoe	epiphyte on trees	unknown		x	x	spr
Phryma leptostachya	American lopseed	mesic forests	infrequent		x	x	spr
Pinus virginiana	Virginia pine	dry slopes ridges	infrequent		x		spr
Plantago aristata	largebracted plantain	warm season grassland (managed)	scarce				spr
Plantago lanceolata	narrowleaf plantain	roadside	infrequent	x	x	x	sum
Plantago rugelli	blackseed plantain	open roadsides	frequent		x	x	spr
Platanus occidentalis	sycamore	floodplain forests	occasional		x	x	spr
Pleopeltis polypodioides var. michauxiana	resurrection fern	limestone boulders, boughs of trees/dry ridges	infrequent				spr
Poa sylvestris	woodland bluegrass	rich woods, bluffs	occasional		x	x	spr
Podophyllum peltatum	May apple	mesic-dry forests	common				spr
Polygala verticillata var. ambigua	whorled milkwort	dry, open disturbed sites	scarce				sum
Polygonatum biflorum	Solomon's seal	mesic slopes/floodplains	occasional				spr
Polymnia canadensis	whiteflower leafcup	mesic forest, seepy slopes	occasional		x		sum
Polystichum acrostichoides	Christmas fern	mesic-dry forests, etc.	common				spr
Populus deltoides	eastern cottonwood	early successional forest, clear cut	scarce				spr
Populus grandidentata	bigtooth aspen	early stage second growth forest	rare		x	x	spr
Porteranthus stipulatus	Indian physic	dry, open disturbed sites	scarce				sum
Prunus serotina	black cherry	dry-mesic forests and floodplains	occasional				spr
Pycnanthemum loomisii	Loomis' mountain mint	dry woods	infrequent			x	sum
Quercus alba	white oak	dry-mesic forests	frequent		x	x	spr
Quercus coccinea	scarlet oak	dry slope forests, ridges	occasional		x		spr

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Quercus falcata	southern red oak	dry-mesic upper slopes and ridges	occasional		x	x	spr
Quercus lyrata	overcup oak	wetland	rare			x	spr
Quercus marilandica	blackjack oak	dry karst oak-hickory forests	very rare		x	x	spr
Quercus muhlenbergii	chinkapin oak	dry slope forests, ridges	infrequent		x	x	spr
Quercus nigra	water oak	disturbed bottomlands, Mill Cr. Headwaters	rare		x	x	spr
Quercus phellos	willow oak	disturbed bottomlands, Mill Cr. Headwaters	rare				spr
Quercus prinus	chestnut oak	dry slope forests, ridges	occasional		x		spr
Quercus rubra	red oak	mesic forests	frequent				spr
Quercus stellata	post oak	dry karst forest	infrequent		x		spr
Quercus velutina	black oak	dry slope forests, ridges	occasional		x	x	spr
Ranunculus abortivus	littleleaf buttercup	mesic forests, ruderal sites	scarce				spr
Ranunculus hispidus	bristly buttercup	dry slopes	occasional				spr
Ranunculus recurvatus	blisterwort	mesic slopes and floodplains	occasional				spr
Rhamnus caroliniana	Carolina buckthorn	dry ridges, slopes	infrequent				spr
Rhus copallinum	winged sumac	forest edge	occasional		x	x	sum
Robinia pseudoacacia	black locust	roadsides, succional forests	occasional				spr
Rosa multiflora	multiflora rose	mesic forests, ruderal sites	infrequent	x			spr
Rubus argutus	southern blackberry	disturbed areas	occasional		x	x	spr
Ruellia caroliniensis	Carolina wild petunia	dry-mesic knob	rare				sum
Sabatia angularis	rose pink	dry, open disturbed sites	infrequent				sum
Saccharum alopecuroidum	silver plume grass	roadside	infrequent			x	sum
Sanguinaria canadensis	bloodroot	mesic forests	infrequent				spr
Sanicula canadensis	Canadian black snakeroot	mesic forests	frequent		x		spr
Sanicula smallii	Small's black snakeroot	dry oak-hickory forests	occasional				sum
Sassafras albidum	sassafras	dry slopes and ridges	frequent				spr
Saxifraga virginiensis	early saxifrage	moist limestone boulders and outcroppings	occasional				spr
Schizachryium scoparium	little bluestem	warm season grassland (managed)	rare				sum
Scleria oligantha	littlehead nut rush	dry-mesic forests	rare		x	x	spr
Scutellaria elliptica var. hirsuta	hairy scullcap	dry woods	infrequent		x	x	spr
Sedum ternatum	woodland stonecrop	rock outcroppings	occasional				spr
Senecio obovatus	roundleaf ragwort	dry, shaley outcropping and ridges	occasional			x	spr

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Sericocarpus linifolius	narrowleaf whitetop aster	dry, open disturbed sites	infrequent		x		sum
Setaria glauca	yellow bristlegrass	open roadsides	infrequent	x	x	x	sum
Silene virginica	fire pink	dry-mesic slope forests	occasional				spr
Silphium trifoliatum var. trifoliatum	whorled rosinweed	dry, open disturbed sites	infrequent				sum
Smallanthus uvedalius	hairy leafcup	roadsides and forest margins	occasional			x	sum
Smilacina racemosa	false Solomon's seal	dry-mesic slopes	occasional				spr
Smilax bona-nox	saw greenbrier	hardwood forests	occasional				spr
Smilax ecirrata	carrion flower	mesic forests	scarce				spr
Smilax glauca	cat greenbrier	mesic forests	infrequent				spr
Smilax rotundifolia	roundleaf greenbrier	mesic forests, successional forests	occasional				spr
Solanum carolinense	Carolina horsenettle	roadsides, food plots	infrequent				sum
Solidago arguta var. boottii	Boott's goldenrod	dry logging road emnbankment	rare				sum
Solidago caesia	wreath goldenrod	mesic forests	occasional				sum
Solidago canadensis var. scabra	Canada goldenrod	dry, open disturbed sites and forests	infrequent		x	x	sum
Solidago erecta	showy goldenrod	dry rocky ridge outcrops	scarce				sum
Solidago flexicaulis	zigzag goldenrod	dry-mesic forests	infrequent			x	sum
Solidago sphacelata	autumn goldenrod	dry rocky ridge outcrops	very rare		x	x	sum
Solidago ulmifolia	elmleaf goldenrod	dry limestone forests	infrequent		x	x	sum
Sorghastrum nutans	Indian grass	warm season grassland (managed)	rare				sum
Staphylea trifolia	bladdernut	lower mesic slopes	occasional				spr
Stellaria media	common chickweed	mesic floodplains/ruderal sites	occasional	x	x	x	spr
Stellaria pubera	star chickweed	mesic forests	infrequent				spr
Stylophorum diphyllum	celandine poppy	mesic forests and forested floodplains	frequent				spr
Stylosanthes biflora	pencil flower	dry rocky slopes	infrequent				sum
Symphoricarpos orbiculatus	coralberry	mesic forests	occasional		x		spr
Synandra hispidula	Guyandotte beauty	rich terraces and slopes	infrequent			x	spr
Taenidia integerrima	yellow pimpernel	dry ridges, slopes, shaley outcroppings	occasional		x		spr
Tephrosia virginica	goat's rue/Virginia tephrosia	dry, open disturbed sites	infrequent		x		spr
Thalictrum diocum	early meadow-rue	mesic floodplain	scarce		x	x	spr
Thalictrum thalictroides	rue anemone	mesic forests	frequent		x	x	spr
Thaspium barbinode	hairyjoint meadow parsnip	floodplains/mesic forests	occasional		x	x	spr
Thaspium chapmanii	Chapman's meadow parsnip	rich floodplain terraces, slopes	infrequent			x	spr

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Thaspium trifoliatum var. flavum	yellow meadow parsnip	rich limestone slopes	infrequent		x	x	spr
Tiarella cordifolia	foamflower	mesic rocky slopes	occasional				spr
Tilia americana	basswood	mesic forests and floodplains	occasional		x		spr
Tipularia discolor	cranefly orchid	dry-mesic forests	occasional				sum
Tovara virginica	jumpseed	moist disturbed places	infrequent		x		sum
Tradescantia subaspera	zigzag spiderwort	dry slopes/ridges	occasional		x	x	spr
Tridens flavus	purpletop tridens	dry, open disturbed sites	infrequent		x	x	sum
Trifolium pratense	red clover	roadsides, food plots	occasional	x	x	x	sum
Trillium cuneatum	little sweet Betsy	mesic forests	frequent				spr
Trillium flexipes	bent trillium/nodding trillium	mesic/moist lower slope	rare		x	x	spr
Trillium grandiflorum	largeflowered trillum	mesic forest and seepage slopes	frequent				spr
Trillium luteum	yellow trillum	mesic forests/floodplains	scarce				spr
Trillium recurvatum	bloody butcher	mesic forests	occasional				spr
Trillium sessile	toadshade/sessile trillium	mesic slopes	scarce				spr
Trillium sulcatum	southern red trillium	mesic slopes	occasional		x	x	spr
Tsuga canadensis	eastern hemlock	disturbed bottomlands, Mill Cr. Headwaters	rare				spr
Ulmus rubra	red elm	roadsides, floodplains	occasional				spr
Uvularia grandiflora	largeflower bellwort	rich mesic forests	occasional				spr
Uvularia perfoliata	perfoliate bellwort	dry-mesic forests	infrequent				spr
Uvularia sessilifolia	sessileleaf bellwort	dry-mesic forests	infrequent				spr
Vaccinium arboreum	farkleberry	dry ridges, slopes	infrequent		x	x	sum
Vaccinium pallidum	lowbush blueberry	dry ridges, slopes, sandstone geology	infrequent		x	x	spr
Vaccinium stamineum	deerberry	dry ridges, slopes	infrequent				spr
Valeriana pauciflora	largeflower valerian	mesic floodplain terraces	infrequent				spr
Verbena urticifolia	white vervain	disturbed roadsides	infrequent				sum
Vernonia gigantea	giant ironweed	roadsides, disturbed open areas	infrequent		x	x	fall
Viburnum acerifolium	maple leaf vibernum	dry-mesic slopes	occasional				spr
Viburnum rufidulum	rusty black haw	dry forests	occasional				spr
Vinca minor	common periwinkle	cemeteries, old homesites	occasional	x			spr
Viola canadensis	Canada violet	mesic forests and floodplains	occasional				spr
Viola pedata	birdfoot violet	dry shaley outcroppings	scarce				spr
Viola pubescens	downy yellow violet	mesic forests and forested floodplains	frequent				spr
Viola rostrata	longspur violet	mesic forests	scarce				spr

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Viola sororia	common blue violet	mesic forest	frequent				spr
Vitis aestivalis	summer grape	karst forests	occasional				spr
Yucca filamentosa	yucca	old home sites/TWRA foodplots	infrequent		x		sum
Zizia aptera	meadow zizia	dry slopes and ridges	occasional		x		spr

Table 3. Bryophytes from Standing Stone State Forest.

Taxon with Authority	Moss/Liverwort
AMBLYSTEGIUM VARIUM (Hedw.) Lindb.	Moss
ANOMODON ATTENUATUS (Hedw.) Hueb.	Moss
ANOMODON ROSTRATUS (Hedw.) Schimp.	Moss
BRYHNIA GRAMINICOLOR (Brid.) Grout	Moss
BRYOANDERSONIA ILLECEBRA (Hedw.) Robins.	Moss
CAMPYLIUM CHRYSOPHYLLUM (Brid.) J. Lange	Moss
CONOCEPHALUM CONICUM (L.) Lindb.*	Liverwort
ENTODON SEDUCTRIX (Hedw.) C.M.	Moss
FISSIDENS CRISTATUS Wils. ex Mitt.*	Moss
FISSIDENS SUBBASILARIS Hedw.	Moss
FORSSTROEMIA TRICHOMITRIA (Hedw.) Lindb.	Moss
FRULLANIA ERICOIDES (Nees) Mont.	Liverwort
FRULLANIA sp	Liverwort
HAPLOHYMENIUM TRISTE (Ces. ex DeNot.) Kindb.	Moss
HOMALOTHECIELLA SUBCAPILLATA (Hedw.) Broth.	Moss
HYPNUM CURVIFOLIUM Hedw.*	Moss
LEUCOBRYUM ALBIDUM (Brid ex P.Beauv.) Lindb.	Moss
MNIUM CILIARE (C.M.) Schimp.	Moss
MNIUM HORNUM Hedw.*	Moss
MNIUM LONGIROSTRUM Brid.*	Moss
NOWELLIA CURVIFOLIA (Dicks.) Mitt.*	Liverwort
ORTHOTRICHUM sp.	Moss
PLATYGYRIUM REPENS (Brid.) BSG*	Moss
PORELLA PLATYPHYLLA (L.) Pfeiff.	Liverwort
THELIA HIRTELLA (Hedw.) Sull.	Moss
THUIDIUM DELICATULUM (Hedw.) BSG	Moss
THUIDIUM DELICATULUM (Hedw.) BSG*	Moss
TORTELLA HUMILIS (Hedw.) Jenn.	Moss

Identification Provided by Paul G. Davison, University of North Alabama

*Indicates a collection made at sinking stream along Table Rock Trail

Table 4. Known Rare Plants from Standing Stone State Forest

Scientific Name	Common Name	State Status	State Heritage Rank
Allium burdickii	Narrow-leaved ramps	Special concern –commercially exploited	S3
Hydrastis canadensis	Goldenseal	Special concern –commercially exploited	S3
Juglans cinerea	Butternut	Threatened	S3
Listera australis	Southern twayblade	Endangered	S1S2
Panax quinquefolius	ginseng	Special concern –commercially exploited	S3S4
Populus grandidentata	Bigtooth aspen	Special concern	S2

Table 5. Expected Management Effects Upon Rare Plants[25]

Definitions of management

Burn – prescribed ecological burn
Rake – doze or root rake
Chop – surface chopping
Thin – thin overstory
Cut – remove overstory
Graze – grazing, livestock
Fence – exclude grazers
Plant – establish plantation
Mowing – includes bushhogging, mechanical
Herbicide – use outside of rare species' growing season for vegetation control

Allium burdickii	Burn	Rake	Chop	Thin	Cut	Graze	Fence	Plant	Mowing	Herbicide
Destroy								X		
Detrimental		X	X	X	X	X				
Possibly Beneficial							X			
Undetermined	X								X	X

Hydrastis canadensis	Burn	Rake	Chop	Thin	Cut	Graze	Fence	Plant	Mowing	Herbicide
Destroy		X			X	X		X		
Detrimental	X			X					X	
Possibly Beneficial							X			
Undetermined			X							X

Juglans cinerea	Burn	Rake	Chop	Thin	Cut	Graze	Fence	Plant	Mowing	Herbicide
Destroy		X	X					X	X	
Detrimental	X				X	X				
Possibly Beneficial				X			X			
Undetermined										X

[25] Adopted from "Guide to Rare Plants - Tennessee Forestry District 5" by Milo Pyne et al. (1995). These management effects are based upon the field knowledge and experience of the previously stated authors and present authors of this document.

Listera australis	Burn	Rake	Chop	Thin	Cut	Graze	Fence	Plant	Mowing	Herbicide
Destroy	X	X	X		X	X		X		
Detrimental				X						
Possibly Beneficial							X			
Undetermined									X	X

Panax quinquefolius	Burn	Rake	Chop	Thin	Cut	Graze	Fence	Plant	Mowing	Herbicide
Destroy					X	X				
Detrimental	X			X				X	X	
Possibly Beneficial							X			X
Undetermined		X	X							

Populus grandidentata	Burn	Rake	Chop	Thin	Cut	Graze	Fence	Plant	Mowing	Herbicide
Destroy	X	X	X					X	X	
Detrimental					X	X				
Possibly Beneficial				X			X			
Undetermined										X

Table 6. Known Rare Animals On and Near Standing Stone State Forest

Hilham USGS Topographic Map				Status		
Scientific Name	**Common Name**	**Date**	**Location**	**State**	**Federal**	**Heritage**
Aneides aeneus	Green salamander	2004	Three locations on State Forest	---	---	S3S4
Corynorhinus rafinesquii	Big-eared bat	2004	State Park adj. Forest boundary	D	MC	S3
Dendroica cerulea	Cerulean warbler	1951	One location on Park	D	MC	S3
Etheostoma obeyense	Barcheek darter	2004	State Park and Forest	---	---	S3
Hemidactylium scutatum	Four-toed salamander	2004	Two locations on State Forest	D	---	S3
Neotoma magister	Eastern woodrat	2004	State Park and Forest	D	MC	S3
Pseudanophthalmus robustus	A cave beetle	2004	One location on State Forest	---	---	S3
Zonitoides lateumbilicatus	Striate gloss	2004	One location on State Forest	---	---	S2
Livingston USGS Topographic Map						
Hemidactylium scutatum	Four-toed salamander	1975	One location on State Forest	D	---	S3
Kleptochthonius pluto	A cave pseudoscorpion	1960's	Raven Bluff Cave	---	---	S1S2
Orconectes australis	Blind cave crayfish	historical	Raven Bluff Cave	---	---	S3
Typhlichthys subterraneus	Southern cavefish	1950's	Water Supply Caves, Livingston	D	MC	S3

State status definitions: D = Deemed in Need of Management
Federal status definitions: MC = Management Concern (a non-legal status)

Table 7. Birds Previosly Known from Standing Stone

American Goldfinch	Kentucky Warbler
American Redstart	Louisiana Waterthrush
Bachman's Sparrow	Magnolia Warbler
Baltimore Oriole	Mourning Warbler
Bay-breasted Warbler	Northern Cardinal
Black-and-white Warbler	Northern Waterthrush
Blackburnian Warbler	Ovenbird
Blackpoll Warbler	Palm Warbler
Black-thr. Green Warbler	Pine Warbler
Brown-headed Cowbird	Prairie Warbler
Canada Warbler	Prothonotary Warbler
Cape May Warbler	Purple Finch
Cerulean Warbler	Red-winged Blackbird
Chestnut-sided Warbler	Rose-breasted Grosbeak
Chipping Sparrow	Scarlet Tanager
Common Grackle	Song Sparrow
Common Yellowthroat	Summer Tanager
Dark-eyed Junco	Swamp Sparrow
Eastern Towhee	White-throated Sparrow
Field Sparrow	Worm-eating Warbler
Hooded Warbler	Yellow-breasted Chat
House Sparrow	Yellow-rumped Warbler
Indigo Bunting	Yellow-throated Warbler

Data from Stedman (2004). These data gave no indication whether the observation was on the State Forest or State Park.

Table 8. Land Molluscs Reported by Dr. Brian Coles

Genus	**Species**	**Common Name**
Anguispira	*cumberlandiana*	Cumberland tigersnail
Carychium	*clappi*	Appalachian thorn
Carychium	*nannodes*	File thorn
Cochlicopa	*morseana*	Appalachian pillar
Columella	*simplex*	High spire column
Discus	*nigrimontanus*	Black Mountain disc
Discus	*patulus*	Domed disc
Euconulus	*chersinus* cf *polygyratus*	Wild hive
Gastrocopta	*contracta*	Bottleneck snaggletooth
Gastrodonta	*interna*	Brown bellytooth
Glyphyalinia	*cumberlandiana*	Hill glyph
Glyphyalinia	*indentata*	Carved glyph
Glyphyalinia	*wheatleyi*	Bright glyph
Guppya	*sterkii*	Brilliant granule
Haplotrema	*concavum*	Gray-foot lancetooth
Helicodiscus	*parallelus*	Compound coil
Inflectarius	*rugeli*	Deep-tooth shagreen
Limax	*maximus*	Giant gardenslug
Mesodon	*thyroidus*	White-lip globe
Mesodon	*zaletus*	Toothed globe
Mesomphix	*anurus*	Frog button
Neohelix	*albolabris*	Whitelip
Pallifera	sp (juveniles)	Mantleslug
Paravitrea	*capsella*	Dimple supercoil
Paravitrea	*metallacta?*	Caneyfork supercoil
Paravitrea	*multidentata*	Dentate supercoil
Patera	*laevior*	Smooth bladetooth
Patera	*perigrapta*	Engraved bladetooth
Philomycus	*carolinianus*	Carolina mantleslug
Pomatiopsis	*lapidaria*	Slender walker
Punctum	*vitreum*	Glass spot
Stenotrema	*hirsutum*	Hairy slitmouth
Stenotrema	*stenotrema*	Inland slitmouth
Striatura	*meridionalis?*	Median striate
Strobilops	*aenea*	Bronze pinecone
Strobilops	*labyrinthica*	Maze pinecone
Triodopsis	*tridentata tennesseensis*	Budded threetooth
Ventridens	*demissus*	Perforate dome
Ventridens	*gularis*	Throaty dome
Zonitoides	*arboreus*	Quick gloss
Zonitoides	*lateumbilicatus*	Striate gloss

Table 9. Fish Collected at Standing Stone

List of fishes collected at Standing Stone State Forest and Park. Fishes deposited in the University of Tennessee Research Collection of Fishes (UT), and tissue biopsies for genetic studies are deposited in the University of Tennessee tissue collection.

8 July 2004
Barn Branch at dirt road below Mill Creek Dam, Standing Stone State Park, ~13 km NW of Livingston, Overton County, Tennessee. N 036.47508, W 085.42041.

2 (51 mm-70 mm) *Campostoma oligolepis* largescale stoneroller (UT 44.10494)
30 (37 mm-53 mm) *Phoxinus erythrogaster* southern redbelly dace (UT 44.10495)
21 (16 mm-69 mm) *Semotilus atromaculatus* creek chub (UT 44.10496)
24 (16 mm-53 mm) *Etheostoma lawrencei* headwater darter (UT 91.6689)
4 (49 mm-60 mm) *Etheostoma obeyense* barcheek darter (UT 91.6690)

8 July 2004
Morgan Creek Standing Stone State Park, ~11.4 km NW of Livingston, Overton County, Tennessee. N 036.45813, W 085.40575.

5 (50 mm-93 mm) *Campostoma oligolepis* largescale stoneroller (UT 44.10532)
1 (102 mm) *Luxilus chrysocephalus* stripped shiner
68 (40 mm-66 mm) *Lythrurus fasciolaris* scarlet shiner (UT 44.10533)
30 (37 mm-53 mm) *Phoxinus erythrogaster* southern redbelly dace (UT 44.10495)
3 (49 mm-65 mm) *Rhinichthys obtusus* orangeside dace
13 (25 mm-61 mm) *Semotilus atromaculatus* creek chub
2 (69 mm-86 mm) *Fundulus catenatus* northern studfish (UT 60.813)
2 (35 mm-41 mm) *Etheostoma flabellare* fantail darter (UT 91.6708)
14 (36 mm-49 mm) *Etheostoma lawrencei* headwater darter (UT 91.6709)
14 (36 mm-59 mm) *Etheostoma obeyense* barcheek darter (UT 91.6710)

8 July 2004
Bryan's Fork Standing Stone State Park, ~12.0 km NW of Livingston, Overton County, Tennessee. N 036.45847, W 085.42591.

60 (27 mm-61 mm) *Phoxinus erythrogaster* southern redbelly dace (UT 44.10497)
6 (26 mm-64 mm) *Rhinichthys obtusus* orangeside dace (UT 44.10498)
25 (17 mm-71 mm) *Semotilus atromaculatus* creek chub (UT 44.10499)
6 (35 mm-50 mm) *Etheostoma lawrencei* headwater darter (UT 91.6691)

6 (31 mm-72 mm) *Etheostoma obeyense* barcheek darter (UT 91.6692)

Note: The collection of *Etheostoma obeyense* at Standing Stone represents a western expansion of the documented range of this species. Etheostoma lawrencei was described in 2002.

Table 10**.** Crayfish Collected at Standing Stone

Crayfish collected at Standing Stone 24-25 June 2004			
Genus	**Species**	**Common Name**	**Location**
Cambarus	*tenebrosus*	cave-spring crayfish	unnamed tributary to Right Fork of Dry Fork, Clay Co.
Cambarus	*tenebrosus*	cave-spring crayfish	Bryans Fork
Cambarus	*graysoni*	(none)	lower Bryans Fork
Orconectes	cf *placidus*	bigclaw crayfish	Bryans Fork
Orconectes	*putnami*	(none)	lower Bryans Fork
Orconectes	*placidus*	bigclaw crayfish	Mill Creek at Dam
* cf, resembles; some male specimens were in non-reproductive molt and were difficult to type to species			

Table 11. Amphibians Recorded at Standing Stone State Park and Forest

Locale	Date	Scientific Name	Common Name	Comments
Cooper Mountain pond	1/27/04	*Rana sylvatica*	wood frog	egg mass rafts
Cooper Mountain pond	2/11/04	*Rana sylvatica*	wood frog	egg mass rafts
		Ambystoma opacum	marbled salamander	larvae
Roadside (Hwy 292) wetland	2/19/04	*Rana sylvatica*	wood frog	egg mass rafts
		Ambystoma maculatum	spotted salamander	egg masses
		Pseudacris feriarum	upland chorus frog	calling nearby
Cooper Mountain pond	2/27/04	*Rana sylvatica*	wood frog	egg mass rafts
		Ambystoma opacum	marbled salamander	larvae
		Ambystoma maculatum	spotted salamander	egg masses
Unnamed tributary north of lake	2/27/04	*Gyrinophilus porphyriticus*	spring salamander	12 indivs
36 28.94; 85 25.15		*Eurycea cirrigera*	two-lined salamander	12 indivs
		Eurycea longicauda	longtail salamander	3 indivs
		Desmognathus fuscus	dusky salamander	6 indivs
		Rana palustris	pickerel frog	1 indiv
		Plethodon dorsalis	zigzag salamander	1 indiv
Roadside (Hwy 292) wetland	2/27/04	*Rana sylvatica*	wood frog	egg mass rafts
		Ambystoma maculatum	spotted salamander	egg masses
		Pseudacris crucifer	spring peeper	calling nearby
Unnamed trib Concord cemetery	3/10/04	*Eurycea cirrigera*	two-lined salamander	12 indivs

Locale	Date	Scientific Name	Common Name	Comments
36 28.00; 85 26.92		*Eurycea longicauda*	longtail salamander	7 indivs
		Desmognathus fuscus	dusky salamander	1 indiv
		Gyrinophilus porphyriticus	spring salamander	2 indivs
		Plethodon dorsalis	zigzag salamander	2 indivs
Cooper Mountain pond	3/10/04	*Rana sylvatica*	wood frog	hatching
		Ambystoma maculatum	spotted salamander	egg masses
		Hemidactylium scutatum	four-toed salamander	14 freshly laid brooded egg clutches
Roadside (Hwy 292) wetland	3/10/04	*Rana sylvatica*	wood frog	hatched
		Ambystoma maculatum	spotted salamander	1 dead/1 live adult
		Pseudacris feriarum	upland chorus frog	calling nearby
		Hemidactylium scutatum	four-toed salamander	1 nest--20 eggs
		Ambystoma opacum	marbled salamander	larvae
Roadside cliff near park office	3/30/04	*Aneides aeneus*	green salamander	1 individual, new county record
36 27.99; 85 25.49				
Borrow pit ponds	3/30/04	*Rana sylvatica*	wood frog	larvae
36 27.51; 85 26.32		*Ambystoma maculatum*	spotted salamander	3 egg masses
		Hemidactylium scutatum	four-toed salamander	1 nest--12 eggs
Rich Branch	4/28/04	*Plethodon dorsalis*	zigzag salamander	sev indivs
		Eurycea cirrigera	two-lined salamander	sev indivs
		Hyla chrysoscelis	Cope's gray treefrog	calling
		Desmognathus fuscus	dusky salamander	sev indivs

Locale	Date	Scientific Name	Common Name	Comments
		Gyrinophilus porphyriticus	spring salamander	
		Eurycea longicauda	longtail salamander	few indivs
		Rana palustris	pickerel frog	
		Bufo americanus	American toad	larvae
Firetower bluffs	4/28/04	*Aneides aeneus*	green salamander	1 indiv
36 26.72; 85 26.59		*Eurycea lucifiga*	cave salamander	17 individuals in rock crevices

Table 12. Recommended Control Methods for Nonnative Invasive Plants

Species	Control Methods							
	Manual Control	Mechanical Control	Prescribed Fire	Grazing	Foliar Application	Cut Treat	Stem Injection	Basal Bark
Rank 1 -- Severe Threat								
Ailanthus altissima, tree-of-heaven	X			X	X	X	X	X
Albizia julibrissin, mimosa	X				X	X	X	X
Elaeagnus umbellata, Russian olive	X				X	X		X
Euonymus fortunei, wintercreeper	X				X	X		
Lespedeza cuneata, sericea lespedeza		X			X	X		
Ligustrum sinense, Chinese privet	X			X	X	X		X
Lonicera x bella, bush honeysuckle	X	X	X		X	X		X
Lonicera japonica, Japanese honeysuckle	X		X		X	X		
Microstegium vimineum, Nepalese grass	X	X			X			
Paulownia tomentosa, Princess tree	X				X	X	X	X
Rosa multiflora, multiflora rose		X			X	X		X
Rank 2 -- Significant Threat								
Berberis thunbergii, Japanese barberry	X	X			X			
Vinca minor, common periwinkle	X				X			